AD-A145 217 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS BEARHOLE RESERVOIR (M..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUN 81 1/2

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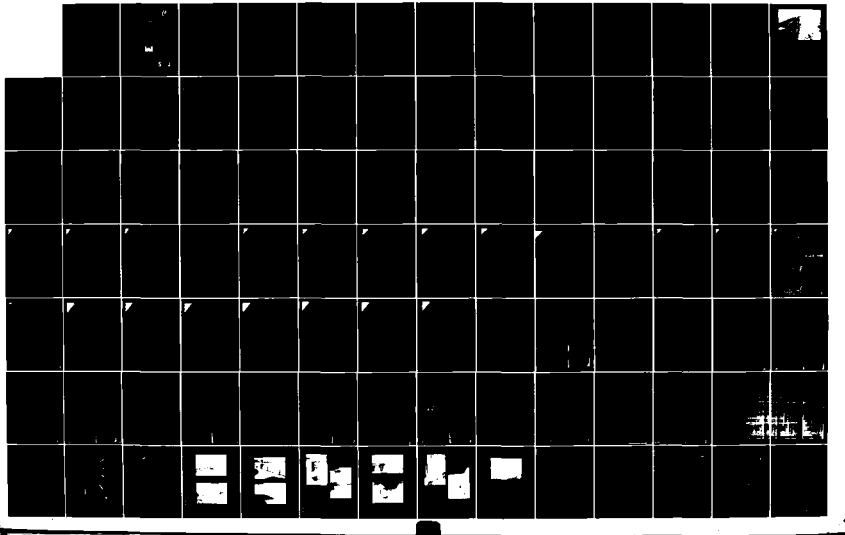

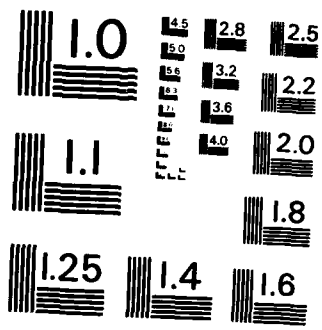

WESTFIELD RIVER BASIN

WEST SPRINGFIELD, MASSACHUSETTS

BEARHOLE RESERVOIR
MA 00073

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JUNE 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Westfield River Basin
West Springfield, Massachusetts

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Bearhole Reservoir Dam is a 270+ foot long, 34 foot high, earth embankment dam. The dam has been classified as "small" in size and "significant" in the hazard category. For a dam of this classification the Guidelines recommend a test flood range of 100-year frequency to ½ the PMF. Generally, the dam is in fair condition

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

JUL 16 1981

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Bearhole Reservoir (MA-00073) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Quality Engineering, and to the owner, City of West Springfield, 26 Central Street, West Springfield, MA, ATTN: Mr. Carl M. Jacobson. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Quality Engineering for your cooperation in this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

BEARHOLE RESERVOIR

MA 00073

WESTFIELD RIVER BASIN
WEST SPRINGFIELD, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No: MA 00073

Name of Dam: Bearhole Reservoir

City: West Springfield

County and State: Hampden County, Massachusetts

Stream: Paucatuck Brook - Tributary of Westfield River

Date of Inspection: March 4, 1981

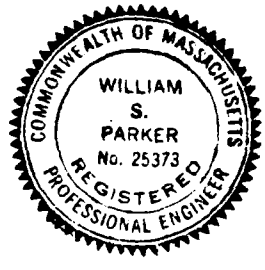
Bearhole Reservoir Dam is a 270± foot long, 34 foot high, earth embankment dam built in 1956 to provide storage and regulate its release as part of the water supply system for the City of West Springfield, Massachusetts. The dam is reported to have a core of select impervious material founded on existing impervious material. The spillway, which is located near the right abutment, is a rectangular concrete box with discharge over the walls on three sides. The spillway weir lengths and elevations are as follows: 6 feet long, El 163.75; 50 feet long, El 165.0; 60 feet long, El 165.25. The outlet conduit for the spillway is a 12 by 12 foot concrete box sluice which discharges to a channel near the downstream toe of the slope. Bearhole Reservoir has a storage capacity of 600 acre-feet with the water level at the top of the dam.

The following deficiencies were observed at the site: spalling concrete in the spillway and outlet structure; seepage emanating from the toe drainage system and on both sides of the box outlet structure; brush growth and tree growth on the downstream slope of embankment; depression in riprap slope on the left side of the outlet channel downstream of the box outlet structure; and broken pavement at the crest of the dam. Generally, the dam is in fair condition.

Based on the Corps of Engineers' Guidelines, the dam has been classified as "small" in size and "significant" in the hazard category. For a dam of this classification the Guidelines recommend a test flood range of 100-year frequency to one-half the Probable Maximum Flood. A test flood equal to 1/2 the Probable Maximum Flood (PMF) was used for this analysis, yielding a peak test flood inflow of 4940 cfs. Hydraulic analyses indicate that the spillway, without flashboards, can discharge 6425 cfs which is greater than the total routed test flood of 4770 cfs. Thus, the spillway can discharge 135% of the routed test flood outflow. At the test flood, the impoundment is estimated to reach an elevation of 1.2-feet below the top of the dam.

It is recommended that the Owner employ a qualified registered professional engineer to prepare plans for rehabilitation of all spalling and erosion of the principal spillway. In addition, the Owner should repair the deficiencies previously listed and, as described in Section 7.3. The Owner should retain a qualified registered professional engineer to investigate the seepage emanating from the toe drainage system and the seepage on both sides of the box outlet structure as it emerges from the downstream toe. It is also recommended that the Owner implement a plan for surveillance of the dam during and after periods of heavy rainfall, establish a formal plan for notifying downstream residents in the event of an emergency at the dam, and implement a program of annual technical inspections by a qualified registered professional engineer.

The measures outlined above and in Section 7 should be implemented by the Owner within a period of one year after receipt of this Phase I Investigation Report.



Cullinan Engineering Co., Inc.

William S. Parker, PE
Director of Engineering
Project Manager

This Phase I Inspection Report on Bearhole Reservoir has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm run-off), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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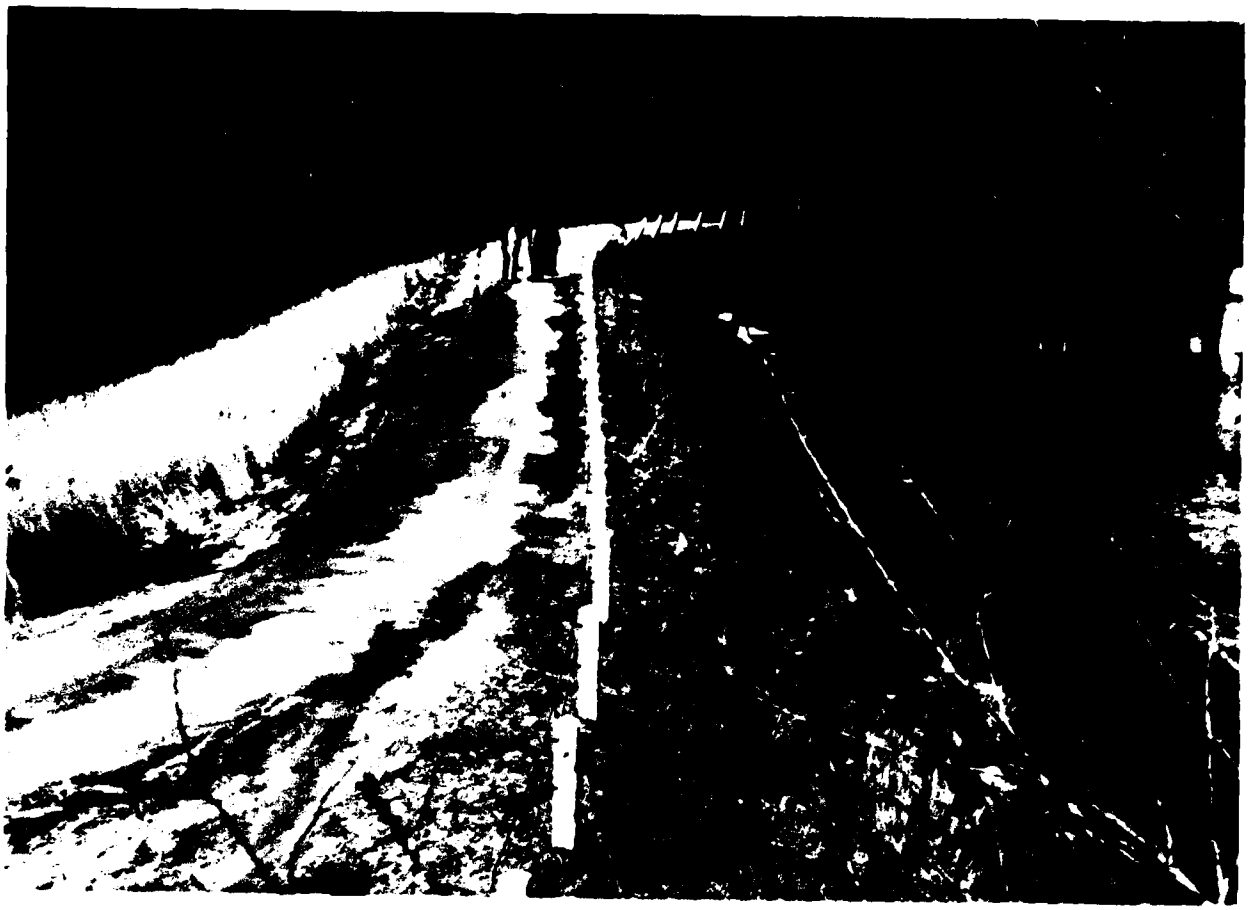
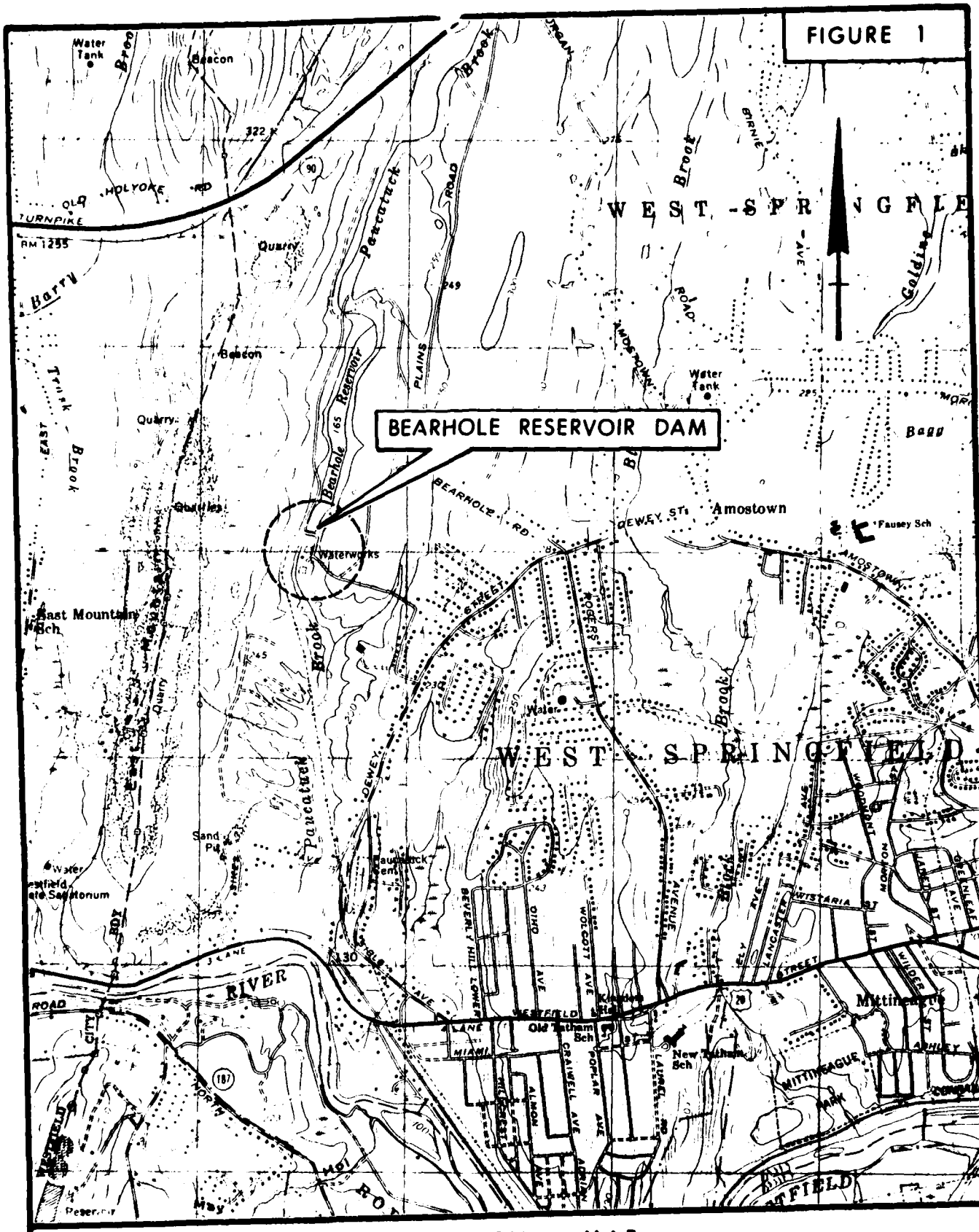
APPENDIXES



OVERVIEW

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam Paucatuc Brook West Springfield, MA MA 00073 March 4, 1981
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		

FIGURE 1



LOCATION MAP

BEARHOLE RESERVOIR DAM
WEST SPRINGFIELD , MASS.
1" = 2083'

MOUNT TOM QUADRANGLE 1979
WEST SPRINGFIELD , MASS-CONN QUADRANGLE 1979

CULLINAN ENGINEERING CO., INC.

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BEARHOLE RESERVOIR

SECTION 1

PROJECT INFORMATION

1.1 General

(a) Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cullinan Engineering Co., Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-81-C-0025, dated December 19, 1980, has been assigned by the Corps of Engineers for this work.

(b) Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

(a) Location. The Bearhole Reservoir Dam is located on Paucatuck Brook, a tributary of the Westfield River, in the City of West Springfield, Hampden County, Massachusetts (See Location Map). The coordinates of this location are latitude 42 degrees 07.6 minutes north and longitude 72 degrees 40.9 minutes west. The dam is located approximately 6800 feet north of the Westfield River.

(b) Description of Dam and Appurtenances. Bearhole Reservoir Dam is an earthfill dam 270 feet long and 34 feet high. The top of the earth embankment is a 13 foot wide paved roadway and is at El 172.0. The earth embankment has an 8-foot wide select impervious core zone with a batter of 1 horizontal to 6 vertical on the downstream side and a batter of 1 horizontal to 3 vertical on the upstream side. There is a cut off trench beneath the impervious zone which was excavated to depths of approximately 6 to 8 feet below original ground surface. The downstream slope of embankment is 3 horizontal to 1 vertical and consists of random pervious fill with a 6-inch layer of loam on the downstream slope. The upstream slope is protected by a 2-foot thick layer of rock riprap (see Photo No. 2) on a 1-foot thick gravel bed. Beneath the gravel bed is a 3-foot zone of select pervious material and the upstream shell zone is semi-pervious material. The upstream slope is 2-1/2 horizontal to 1 vertical.

A toe drainage system consisting of a 4-foot by 6-foot gravel filled trench surrounded by a 2-foot sand filter was placed under the downstream toe of the embankment and discharges in a riprapped outlet channel at the left of the outlet end of the spillway box structure.

The spillway is a rectangular concrete box drop inlet spillway with an intake well for the water supply (see Photos No's. 2, 3, and 4). Inflow into the spillway occurs over 2 sides of the structure, 50 and 60 feet long respectively, and over a 6 foot long section at the upstream end of the spillway. Flashboards can be installed at the 6 foot section only (see Photos No's. 5 and 7). The elevations for the various weirs are 6 foot weir without flashboards, El 163.75; 50 foot weir, El 165.0; and 60 foot weir, El 165.25.

There is also a 30-inch by 36-inch inlet at the upstream end of the spillway structure. Flow through this inlet is controlled by a manual handwheel operated sluicegate. Inflow from the spillway is discharged through a 12 by 12 foot concrete box sluiceway, approximately 127 feet long (see Photo No. 8). Concrete seepage rings were placed on both sides of the concrete box structure and underdrainage consisting of an 8-inch pipe and gravel is reported to have been placed beneath the downstream portion of the outlet structure.

Also, a 24-inch diameter raw water supply line which is encased in 16-inches of concrete is contained in the sluiceway structure. The sluiceway discharges into a channel at the downstream toe of the slope. By field measurements, the elevation of the channel bed at the discharge end of the sluiceway is 138.0. The channel has 2:1 side slopes covered with rock riprap (see Photo No. 10).

The inlet for the raw water supply line is through two 16-inch inlets in an intake well located at the upstream end of the spillway structure. The 16-inch inlets are at El 151.0 and El 140.5. Both inlets are controlled by manual handwheel operated sluicegates. There is also a 6-inch manually operated sluicegated outlet at El 139.5 to drain the intake well into the spillway chamber. Inflow raw water flows through two 1/4-inch mesh wire screens in the intake screen well before passing to the water treatment plant 400-feet upstream by means of a 24-inch lock joint pipe.

(c) Size Classification. According to the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, a dam is classified as "Small" in size if the height is between 25 feet and 40 feet, or the dam impounds between 50 Acre-Feet and 1,000 Acre-Feet. The maximum height of the dam is approximately 34 feet and the estimated total storage capacity at the top of the dam is 600 acre-feet. Thus, the dam is classified in the "small" category based on both storage capacity and height.

(d) Hazard Potential. The results of the dam failure analysis indicate that a water treatment plant, 2 minor roads, a railroad, a major highway (Route 20) and the Westfield River would all be subject to flooding in the event of a dam failure overflow. Anticipated flood waters at the water treatment plant were calculated to be approximately 5 feet above the sill of the structure as opposed to a prefailure depth of about 1 foot. Consequently, with the potential loss of a few lives, the loss of a water supply for the City of West Springfield, and the appreciable economic loss, the dam is classified in the "significant" hazard category.

(e) Ownership. The dam is owned by the City of West Springfield. The owner is represented by Mr. Carl M. Jacobson, Superintendent of the West Springfield Water Department, 26 Central Street, West Springfield, Massachusetts (Phone 413-781-7550, ext. 245 or 253).

(f) Operator. The dam is operated by personnel for the West Springfield Water Department, represented by Mr. Carl M. Jacobson, Superintendent, as stated above.

(g) Purpose of Dam. Bearhole Reservoir Dam provides storage and regulates its release as part of the water supply system for the City of West Springfield, Massachusetts.

(h) Design and Construction History. The present Bearhole Reservoir Dam was constructed in 1956-1957 under the contract for "Reconstruction of Flood Damage at Bearhole Dam" to replace the old dam (approximately 200 feet upstream) which was destroyed in the flood of August 1955. Drawings dated May 1956 and prepared by Tighe & Bond are available for review at the West Springfield Water Department. The drawings show that the dam was constructed essentially as it appears today.

Previous inspection reports indicated that, since construction, the dam has been in good condition and that no major repairs have been made.

(i) Normal Operating Procedures. Personnel from the West Springfield Water Department reportedly are on the site daily to check the dam and monitor activities at the water treatment facility downstream. The only records kept pertinent to the dam are reservoir levels and rainfall amounts which are recorded on forms kept at the Water Department Office.

1.3 Pertinent Data. Normal water surface elevation of 165.0 as shown on the USGS Mount Tom Quadrangle, Massachusetts, 1979, was adopted as the 50 foot long spillway crest elevation. All other elevations given in this report were estimated from the assumed spillway crest elevation. Elevations refer to National Geodetic Vertical Datum (NGVD) formerly referred to as Mean Sea Level.

(a) Drainage Area. The drainage area tributary to the dam is 5.43 square miles. The pond is surrounded by moderately sloped hills which are heavily forested. Elevations within the watershed range from a low of El 165, reservoir level, to El 720 at the northerly end of the watershed area. There is only minor residential development in the drainage area. Bearhole Reservoir accounts for approximately 0.4 percent of the total drainage area. Total upstream ponds account for about 7.4 percent and marshlands 2.9 percent of the total watershed.

(b) Discharge at Dam Site. Normal discharge is over the sides of the rectangular concrete box drop inlet type spillway. The weir lengths of the spillway are 6, 50 and 60 feet with elevations of 163.75, 165.0 and 165.25 respectively. Flashboards can be installed at the 6-foot section only. Inflow from the spillway is discharged through a 12-foot by 12-foot concrete box sluiceway, approximately 127 feet long. The sluiceway discharges to a natural brook channel at the downstream toe of the slope.

The spillway can discharge an estimated 6425 cfs with the water surface at El 172.0 which is the elevation of the crest of the dam. The routed outflow test flood (one-half the Probable Maximum Flood) is 4770 cfs at El 170.8 which indicates that the outflow test flood will not overtop the dam, ignoring wave action.

The following is a list of pertinent values relative to discharge:

1.	Outlet Works (Conduit) Size:	(a) 16 inch (b) 16 inch (c) 30 x 36 inch
	Invert Elevation:	(a) 150.3 (b) 139.8 (c) 139.8
	Discharge Capacity:	(a) 42 cfs (b) 52 cfs (c) 278 cfs
2.	Maximum Known Flood at Dam Site:	Flood on August 19, 1955 (magnitude unknown) washed out dam 200 feet upstream of the present dam.
3.	Ungated Spillway Capacity at Top of Dam: Elevation:	6425 cfs 172.0
4.	Ungated Spillway Capacity at Test Flood Elevation: Elevation	4770 cfs 170.8
5.	Gated Spillway Capacity at Normal Pool Elevation: Elevation:	N/A
6.	Gated Spillway Capacity at Test Flood Elevation: Elevation:	N/A
7.	Total Spillway Capacity at Test Flood Elevation: Elevation:	4770 cfs 170.8
8.	Total Project Discharge at Top of Dam: Elevation:	6425 cfs 172.0
9.	Total Project Discharge at Test Flood Elevation: Elevation:	4770 cfs 170.8

c. Elevation - Feet Above NGVD (formerly MSL Datum of 1929)

1.	Streambed at Toe of Dam:	138.0
2.	Bottom of Cutoff:	N/A (not applicable)
3.	Maximum Tailwater:	Unknown
4.	Normal Pool:	165.0
5.	Full Flood Control Pool:	N/A
6.	Spillway Crest:	6-foot - 163.75 50-foot - 165.0 60-foot - 165.25
7.	Design Surcharge - Original Design:	168.0
8.	Top of Dam:	172.0
9.	Test Flood Surcharge:	170.8

d. Reservoir - Length in Feet

1.	Normal Pool:	3540 feet
2.	Flood Control Pool:	N/A
3.	Spillway Crest Pool:	3540 feet (crest at El 165.0)
4.	Top of Dam:	3700 feet
5.	Test Flood Pool:	3670 feet

e. Storage - Acre-Feet

1.	Normal Pool:	450 acre-feet
2.	Flood Control Pool:	N/A
3.	Spillway Crest Pool:	450 acre-feet (crest at El 165.0)
4.	Top of Dam:	600 acre-feet
5.	Test Flood Pool:	570 acre-feet

f. Reservoir Surface - Acres

1.	Normal Pool:	17 acres
2.	Flood Control Pool:	N/A
3.	Spillway Crest:	17 acres (crest at El 165.0)
4.	Test Flood Pool:	23 acres
5.	Top of Dam:	24 acres

g. Dam

1.	Type:	Earthfill
2.	Length:	270 feet
3.	Height:	34 feet
4.	Top Width:	13 feet
5.	Side Slopes	2.5 Horizontal to 1 Vertical Upstream 3 Horizontal to 1 Vertical Downstream
6.	Zoning:	See Plans
7.	Impervious Core:	8 feet wide at top Upstream Batter 1 Horizontal to 6 Vertical Downstream Batter 1 Horizontal to 3 Vertical
8.	Cutoff:	Core wall extends to top of existing impervious material
9.	Grout Curtain:	None
10.	Other:	Gravel underdrain at downstream toe

h. Diversion and Regulating Tunnel — N/A

i. Spillway

1.	Type:	Rectangular concrete box with discharge over walls on three sides
2.	Length of Weir:	6 feet 50 feet 60 feet
3.	Crest Elevation with Flashboards: without Flashboards:	 6 feet - 165.75 6 feet - 163.75 50 feet - 165.0 60 feet - 165.25

4.	Gates:	N/A
5.	Upstream Channel:	Natural bed of Paucatuck Brook
6.	Downstream Channel:	Natural bed of Paucatuck Brook
7.	General:	Flow from spillway outlets through a 12 foot by 12 foot concrete box conduit to the downstream channel

j. Regulating Outlets

1.	Invert:	(a) 150.3 (b) 139.8 (c) 139.8
2.	Size:	(a) 16 inch (b) 16 inch (c) 30 x 36 inch
3.	Description:	(a)(b) Inlets to intake well for raw water supply. (c) Outlet at north end of spillway structure.
4.	Control Mechanism:	Manually operated sluice gates (all outlets)
5.	Other:	Outlet from intake well is 24-inch lock joint pipe (invert 139.5) encased in concrete within 12 foot by 12 foot concrete box conduit. The 24-inch outlet runs to water treatment plant 400 feet downstream of the dam and is controlled by a manually operated sluice gate at the intake well.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

A complete set of design plans (stamped record plans) were obtained from the West Springfield Water Department. The plans entitled "Reconstruction of Flood Damage at Bearhole Dam" May 1956, were drawn for the construction contract to replace the old dam (approximately 200-feet upstream) which was destroyed in the flood of 1955. The plans were prepared by Tighe & Bond, Consulting Engineers, Holyoke, Massachusetts (see Appendix B).

2.2 CONSTRUCTION

The above-mentioned plans are labeled as record plans and are in general conformity with the existing structure with the following exceptions. The top of the dam appears to be about 2 feet higher (El 172) in relation to elevations of the concrete spillway structure than shown on the cross sections contained in the plans. Also, the top of the dam is only 13 to 14 feet wide instead of 20 feet as the plans denote. These discrepancies between the crest width and elevation can apparently be attributed to the construction of a paved access road across the crest of the dam. It appears that the road was added during the construction phase of the dam, as page 3 of the Record Plans (see Appendix B) denotes an access road approximately 12 feet wide at El 172, and that the cross sectional record plans were never modified to reflect this change. In addition, a concrete post and cable guard has been installed along the upstream side of the roadway. Periodic inspection reports by the Massachusetts DPW indicate that since its construction, the dam has been in good condition and no major repairs have been made.

2.3 OPERATION

Daily operating records are kept by personnel from the Water Department and maintained at the office of the West Springfield Water Department, 26 Central Street, West Springfield, Massachusetts.

2.4 EVALUATION

a. Availability. Documents described above are available at the City of West Springfield Water Department, Hampden County, Massachusetts, and The Division of Waterways, State of Massachusetts.

b. Adequacy. The available data, in combination with the visual evaluation described in the following section, is adequate for the purpose of the Phase I Investigation.

c. Validity. Except for the elevation and width of the crest of the dam, the general observed configuration of the dam and appurtenances appear to be in agreement with the record plans.

SECTION 3
VISUAL INSPECTION

3.1. Findings

(a) General. Bearhole Dam is a compacted earthfill embankment having a crest length of approximately 270 feet. There is a principal spillway consisting of a concrete box structure located near the right abutment and discharging near the downstream toe of the embankment fill. Bearhole Reservoir Dam is in FAIR condition at the present time.

(b) Dam. The alignment of the upstream slope is good and the riprap is generally in good condition, however, there is some very minor small grass growth on the upstream slope which should be trimmed. An area of minor sloughing of the riprap caused by slope creep is located at the left training wall of the spillway for a distance of approximately 30 feet.

Along the crest of the dam is a paved access road with a concrete post and cable guard along the upstream side of the roadway. It was observed that the pavement is deteriorated and in need of repair or replacement.

There is heavy brush growth and small tree growth near the right abutment of the downstream slope with some minor brush growth on the remainder of the downstream slope and a single tree growing at the left abutment.

A depression approximately 6 feet square by a maximum of 2-feet deep is located in the riprap slope approximately 10 feet left of the left wall of the box outlet structure as it emerges from the downstream slope of the embankment (see Photo No. 11). Ravelling of the underlying fines through the riprap is the apparent cause of the settlement.

Some seepage is issuing from the downstream toe of the embankment. This seepage is flowing clear and clean and is located 5 feet upstream of the right wall of the outlet structure and 3 to 4 feet normal to the wall where it emanates from the riprap slope. Additionally, a considerable amount of clear and clean seepage is issuing from the riprap slope at the downstream toe of embankment adjacent to the left wall of the outlet structure to a distance of 30 feet downstream (see Photo No. 9). The total seepage is estimated to be 20 to 30 GPM on the left side of the channel and 5 to 10 GPM on the right side.

The outlet channel downstream of the outlet structure and the riprap protecting the slopes is generally in good condition (see Photo No. 10).

(c) Appurtenant Structures. The spillway structure consists of a rectangular concrete box drop inlet spillway with an internally cast raw water intake well. The structure extends into the impoundment pool normal to the dam axis with a 60-foot spillway on the right side, a 50-foot spillway on the left side and a 6-foot spillway on the outboard end with all crests being 18 inches wide (see Photos No's. 2, 3, and 4). The raw water intake well is located on the left outboard end of the structure. A timber framed footbridge 3-feet wide with a pipe rail fence and 42-inch high chain link fencing spans the length of the structure from the earth embankment to the raw water intake well (see Photo No. 2). Three buttress type walls (struts) 11.5-feet deep, the lower 4-feet being a 2-foot wide ledger beam and the top 7.5-feet being 1-foot wide, internally brace the long walls of the structure (see Photo No. 3). Projecting piers above the struts support the footbridge. A 4.5-foot concrete encasement for the 24-inch raw water supply to the treatment plant has been cast at the base of the west well and along the entire length of the left spillway wall.

Spalling and surface erosion has occurred on the top surface of the struts and the ledger beams. Furthermore the interface between the sidewalls and the struts has been subjected to cracking, efflorescence and in some instances exudation. The top surface of the raw water pipe encasement has been subjected to surface erosion. Surface repairs as a result of spalling of the platform over the raw water intake well have been subjected to random surface cracking (see Photo No. 6). The sidewalls of the structure has been subjected to horizontal and vertical cracking and are effloresced. Surface spalling has occurred at the right outboard end of the structure.
A flashboard consisting of 3/4-inch plywood spans across the 6-foot long sluiceway. The flashboard is approximately 24-inches high. It is held in place by means of a chain attached to the waste gate bench stand. There is considerable seepage flowing around the flashboard (see Photo No. 5).

The footbridge, railing and chain link fence are in good condition.

There are five gates at the outboard end of the structure. Four are equipped with Chapman bench stands with rising stems and hand crank operators. The fifth gate is nut operated below the platform level. Hand cranks have been removed from the site in order to prevent unauthorized use. The extreme right gate functions as a reservoir draw down, this waste gate is 30 x 36 inches and is fabricated from cast-iron. It is reported that this waste gate has never been operated. The two upstream bench stands on the right side of the structure operate 16-inch gates which control the entrance of the raw

water supply (see Photo No. 6). The inboard bench stand operates a 24-inch gate for raw water supply to the water treatment plant. The nut operated gate controls a 6-inch valve for dewatering the raw water wet well. One raw water supply gate was fully opened; the other opened 1-inch, and the 24-inch outlet gate was fully opened. The waste gate was closed. All bench stands are well maintained and, with the exception of the waste gate, are operated on a continuous basis. A galvanized checkered plate covers an opening 5 x 2 feet for access to screens. A 24-inch manhole cover is lcoated adjacent to the bench stand operating the 24-inch gate (see Photo No. 6). The access panel and the manhole cover are in good condition.

The outlet structure consists of a 127 foot long, 12 x 12 foot reinforced concrete conduit with an 18-inch thick roof and sidewalls. The concrete encasement for the 24-inch raw water supply line is located on the left side of this structure, terminating approximately 10-feet from the outlet end of the culvert. With the exception of minor surface erosion on the invert slab, the culvert is in good condition. A 24-inch diameter access manhole is bolted in place at the terminating end of the concrete encasement.

(d) Reservoir Area. No development has occurred along the shore of Bearhole Reservoir. The area is heavily wooded and hilly, with steep slopes down to the reservoir. There is little potential that future development will occur in the reservoir area.

(e) Downstream Channel. Bearhole Reservoir discharges into a well defined channel free of any debris with 2:1 side slopes covered with riprap. The outflow then follows the natural stream bed of Paucatuck Brook, passing underneath two minor roads, a railroad, and a state highway (Route 20) before reaching the Westfield River, approximately 6800-feet downstream of the dam.

3.2 Evaluation

The visual inspection indicates that the dam is in fair condition. There are some deficiencies which must be corrected to assure the continued performance of this dam. Items of concern observed during the inspection include the following:

(a) seepage on both sides of the outlet structure at the downstream toe of the dam that can lead to erosion and piping;

(b) sloughing of the riprap on the upstream slope to the left of the spillway resulting in a loss of slope protection and potential erosion;

(c) brush and tree growth on the downstream slope with root systems that can effect the integrity of the embankment;

(d) a depression in the riprap slope on the left side of the outlet channel causing a loss of slope protection and possible erosion;

(e) deteriorated pavement on the crest of the dam resulting in a loss of protection of the crest and possible erosion; and,

(f) spalled concrete in the spillway and outlet structure which compromises the structural integrity of the outlet and could lead to further deterioration of the outlet.

Measures to improve these conditions are stated in Sections 7.2 and 7.3.

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

(a) General. The dam is maintained by the West Springfield Water Department. Records of air temperature, water level, and rainfall are taken daily at 7:15 AM by Water Department personnel and are maintained at the Water Department Office at 26 Central Street, West Springfield, Massachusetts.

(b) Warning System. There is no established warning system or emergency preparedness plan in effect for this structure.

4.2 Maintenance Procedures

(a) General Maintenance of the dam is performed on an informal basis rather than on a formally established routine or procedure. The dam is generally maintained in fair condition.

(b) Operating Facilities. A flashboard consisting of 3/4 inch plywood and approximately 24 inches in height can be installed at the 6 foot long spillway. Considerable seepage is flowing around this flashboard. The bench stands and hand crank operators for the control valves are well maintained and operable (see Photos No's. 5, 6, and 7). It is reported that all sluice gates, except the 30-inch by 36-inch sluicegate, are operated at least once a year. The 30-inch by 36-inch sluice gate for draining the reservoir has reportedly never been opened. Spalling and surface erosion have occurred on the spillway structure (see Photos No's. 5, 6 and 7). The footbridge, railing, and chain link fence are in good condition.

4.3 Evaluation

Maintenance of the facility is performed on an informal basis and the overall maintenance procedure should be expanded to include the monitoring of seepage. There is no regular program for technical inspections of the dam. Formal maintenance procedures, warning system, and annual technical inspections by a qualified registered professional engineer should be established. An "Emergency Action Plan" should be developed to include an effective preplanned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation. Also, the 30 by 36 inch sluice gate should be operated regularly to insure that it remains functional. These programs should be implemented as recommended in Section 7.3.

SECTION 5
EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Bearhole Reservoir Dam is a 270 foot long, 34 foot high earth embankment dam which is fed by Paucatuck Brook and forms a water supply impoundment in West Springfield, Massachusetts. The watershed is 5.43 square miles of rolling terrain with eight (8) upstream ponds and some swampy areas. The rectangular concrete box spillway receives flow from three (3) sides of different lengths and elevations. The weir lengths are 6, 50, and 60 feet with elevations of 163.75, 165.0, and 165.25, respectively. The crest elevation of the 6 foot spillway with flashboards is 165.75. The outlet for the spillway is a 12 foot by 12 foot concrete box conduit.

5.2 Design Data

Hydraulic and hydrologic computations are not available for the design of the spillway.

5.3 Experience Data

Records of water level, and rainfall are kept by the West Springfield Water Department. These records are maintained at the Water Department Office, 26 Central Street, West Springfield, Massachusetts.

A notable flood occurred at the Reservoir on August 19, 1955, when a previous dam was overtopped at a location immediately upstream of the present dam.

5.4 Test Flood Analysis

Based on the Corps of Engineers Guidelines, the recommended test flood range for the size (small) and hazard potential (significant) is a 100- year frequency to one-half Probable Maximum Flood (PMF). Because a failure of the dam would cause a loss of water supply, appreciable economic loss, and the possible loss of a few lives, one-half the PMF was adopted as the test flood inflow. The watershed terrain is mostly rolling with a gentle slope (approximately 1.9%) and a considerable amount of upstream ponded water (approximately 7.4% of the total drainage area) and marshland (another 2.9%). Applying one-half the PMF (910 CSM) to the 5.43 square miles of drainage area results in a calculated peak flood flow of 4940 cfs as the inflow test flood. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 4770 cfs. The spillway capacity is 6425 cfs with the water surface at the top of the dam, which represents 135% of the peak test flood outflow.

As the top of dam is at El 172.0, the routed test flood outflow of 4770 cfs at a stage of 170.8 would result in a freeboard of 1.2 feet, assuming no flashboards in the 6 foot spillway and the sluicegates closed for the various pipe outlets. Therefore, the spillway can discharge the full test flood without overtopping the dam. Even with flashboards in place on the 6-foot spillway overtopping of the dam would not occur.

5.5 Dam Failure Analysis

Based on the Corps of Engineers Guidelines for estimating dam failure hydrographs, and assuming a breach width of 60-feet which represents 40 percent of the mid-height length of 150-feet, at a water surface elevation of 172.0, the dam failure outflow would be 20,000 cfs. This does not include the discharge from the spillway as it is assumed that the spillway is included in the breach. As a result of a dam failure, the water treatment plant and pumping station, approximately 400 feet downstream, would be inundated. Other areas downstream which would be subject to some flooding are a power line (2900± feet downstream from the dam), two (2) minor roadways (5300± and 6250± feet) a railroad track (6450± feet), a state highway, Route 20 (6650± feet) and the Westfield River (6800± feet).

The hazard potential for Bearhole Reservoir is based upon the appreciable economic loss, due to the loss of water supply and the damage at the water treatment plant and pumping station, that would be incurred as a result of dam failure. In addition, there is potential for the loss of a few lives depending upon the number of people working at the water treatment plant at the time of dam failure. Calculations (see Appendix D) indicate that the depth of flow in the downstream channel adjacent to the water treatment plant prior to failure would be on the order of 5.9 feet (El 145.9) while the depth following failure would be 10.3 feet (El 150.3). The water treatment plant and pumping station is estimated to be at El 145.0, therefore, while both conditions would cause flooding, the plant to be under approximately 5-feet of water (as compared to about 1-foot prior to failure) at which depth it is anticipated that extensive damage would occur. Downstream of Section 4 (see Appendix D) are several other potential damage areas (as outlined in the previous paragraph), however, since the channel widens considerably through this area, flooding is expected to be minor with minimal economic loss and no potential for loss of life. Based upon the appreciable economic loss at the water treatment plant and potential loss of a few lives, the hazard potential due to a failure of the Bearhole Reservoir Dam is "significant".

SECTION 6
EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The field inspection of the embankment, spillway, and outlet channel indicates that these structures are in fair condition. Spalling and erosion was observed on the principal spillway (see Photos No's 5, 6, and 7). No structural deficiencies were noted which would warrant further investigations. However, there are several items of a maintenance nature and items requiring continuous monitoring as outlined in Section 7. Further indepth engineering studies do not appear to be warranted. However, a yearly inspection should be made to monitor any changes in the seepage noted at the downstream toe of the embankment.

6.2 Design and Construction Data

Definitive plans of the embankment and spillway were reviewed and appear to be consistent with the superficial features observed. Laboratory test data of the soils forming the embankment was not available, therefore, calculations pertaining to the stability of the embankment are not available.

6.3 Post-Construction Changes

No changes appear to have been made since the original construction of the dam.

6.4 Seismic Stability

The dam is located in Seismic Zone No. 2 and in accordance with Corps of Engineers' Guidelines does not warrant further seismic analysis at this time.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

(a) Condition. The Bearhole Dam is in fair condition at the present time. The major items of concern are the seepage noted on both sides of the box outlet structure at the downstream toe of the dam, the sloughing of the riprap on the upstream slope to the left of the spillway, the brush growth and tree growth on the downstream slope, the depression in the riprap slope caused by the ravelling of fines through the riprap, thereby creating a settlement of the riprap on the left side of the outlet channel, the deteriorated road paving at the crest of the dam caused by an apparent insufficient thickness of pavement and spalled concrete in the spillway and outlet structure.

(b) Adequacy of Information. Design drawings are available for the dam embankment and spillway. Consequently, the adequacy of the engineering data is considered good. The assessment of this dam is based on a review of these drawings plus the visual inspection conducted on March 4, 1981.

(c) Urgency. The recommendations and remedial measures are enumerated below and should be implemented by the owner within one year of receipt of this Phase I inspection report.

7.2 RECOMMENDATIONS

It is recommended that the services of a qualified registered professional engineer be retained to:

(a) Prepare plans for rehabilitation of all spalling and erosion of the principal spillway and outlet structure.

(b) Fill in depression in the riprap slope on the left side of the outlet channel downstream of the box outlet structure with graded rock riprap.

(c) Investigate the seepage emanating from the toe drainage system and the seepage issuing from both sides of the box outlet structure as it emerges from the downstream toe. Pay particular attention to changes in the quantity and clarity of the seepage issuing from the toe of the dam.

7.3 REMEDIAL MEASURES

(a) Operation and Maintenance Procedures

(1) Remove brush growth and tree growth on the downstream slope of embankment and within 15 feet of the toe of the embankment and trim grass growth on the upstream slope of embankment.

(2) Monitor seepage with particular attention paid to any change in the quantity or clarity until the recommendations of the aforementioned engineering study have been implemented.

(3) Repair the broken pavement at the crest of the dam.

(4) Investigate the operability of the 30 x 36 inch sluice gate to insure its continued performance.

(5) Implement a formal program of yearly technical inspections by a qualified registered professional engineer.

(6) Develop an "Emergency Action Plan" that will include an effective preplanned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation.

7.4 ALTERNATIVES

There are no practical alternatives to the above recommendations and remedial measures.

APPENDIX A

INSPECTION CHECKLISTS

INSPECTION TEAM ORGANIZATION

Date: March 4, 1981

Project: MA 00073
Bearhole Reservoir Dam
West Springfield, Massachusetts

Weather: Clear, cold

INSPECTION TEAM

William S. Parker	Cullinan Engineering Co., Inc. (CEC)	Team Captain
Kenneth W. Hodgson, Jr.	CEC	Hydraulics
Gregory M. Valiton	CEC	Hydraulics
William S. Zoino	Goldberg, Zoino & Associates (GZ)	Soils
Steve Trettel	GZ	Soils
Andrew Christo	Andrew Christo Engineers, Inc (ACE)	Structures
Paul Razgha	ACE	Structures
Carl Razgha	ACE	Structures

Owner was not represented at inspection

NOTE: Observed water surface elevation in reservoir at time of inspection = El 165.0±

BEARHOLE RESERVOIR DAM
MA 00073

March 4, 1981

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
UPSTREAM SLOPE		
Vegetation	GZ	Minor grass and brush
Sloughing or Erosion		Minor settlement (12") to a distance of 20' left of left spillway
Rock Slope Protection - Riprap Failures		Good - None except settlement noted
Animal Burrows		None
CREST		
Vegetation		None
Sloughing or Erosion		None
Surface Cracks		Numerous on downstream side of paved surface
Movement or Settlement		None
DOWNSTREAM SLOPE		
Vegetation		6" pines at abutment - minor brush
Sloughing or Erosion		None
Surface Cracks		None
Animal Burrows		None
Movement or Cracking Near Toe		Settlement of riprap adjacent to concrete box outlet structure. One 6' x 6' pothole on left side
Unusual Embankment or Downstream Seepage	GZ	Seepage both sides of box. 20 to 30 GPM left side, 5 to 10 right side

BEARHOLE RESERVOIR DAM
MA 00073

March 4, 1981

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMAPKS
Piping or Boils	GZ	None
Foundation Drainage Features		None
Toe Drains		None
GENERAL		
Lateral Movement		Good
Vertical Alignment		Good
Horizontal Alignment		Good
Condition at Abutments and at Structures		Settlement of riprap along box structure
Indications of Movement of Structural Items		None
Trespassing		None
Instrumentation Systems	GZ	None
PRINCIPAL SPILLWAY		
Condition of Concrete	ACE	Good
Spalling		Top surface of outboard strut 4' long x 3' deep. Top corner of water intake platform spalled 10' x 4". Right spillway crest 2' x 18" x 2" at two locations
Ledger	ACE	Ledger of outboard strut eroded 3' x 2". Minor at ledger of inboard strut. Surface erosion on top of concrete encasement

BEARHOLE RESERVOIR DAM
MA 00073

March 4, 1981

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Cracking	ACE	Minor at ledger beam of outboard strut. Minor at ledger beam of inboard strut. Minor at interface of struts and sidewalls. Random surface cracking on water intake platform. Cracks on left vertical face of platform 90% of length by height of 18". Cracks on right vertical face 6' long x 12" high.
Efflorescence		Located at all cracks.
Exudation		Minor on ledger beam of inboard and outboard struts and sidewalls.
Rusting or Staining of Concrete		None noted
Visible Reinforcing		None noted
Seepage		None noted
Flashboard		3/4" plywood supported by chain. Considerable seepage around flashboard.
Footbridge		All components including beams, decking, metal railing and chain link fence are in good condition.
GATES		
Bench Stands		All bench stands are in good condition and operable
Access Openings	ACE	Checkered plate cover and manhole cover in good condition.

BEARHOLE RESERVOIR DAM
MA 00073

March 4, 1981

CHECKLISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
OUTLET CONDUIT		
Condition of Concrete	Ace	With the exception of minor surface erosion of invert slab there was no evidence of spalling, cracking, efflorescence, rusting or staining of concrete or visible reinforcing

The Commonwealth of Massachusetts

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGR.
DIVISION OF WATERWAYS

100 Nashua Street, Boston 02114

June 11, 1976

West Springfield Water Department
26 Central Street
West Springfield, Massachusetts

RE: Inspection Dam #2-7-325-6
West Springfield
Bear Hole Reservoir Dam

ATT: Mr. Carl M. Jacobson

Gentlemen:

On January 2, 1976 , an Engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate the owner to be W.Springfield Water Department. If this information is incorrect will you please notify this office.

The inspection was made in accordance with the provisions of Chapter 253 of the Massachusetts General Laws as amended (Dams-Safety Act). Chapter 706 of the Acts of 1975 transferred the jurisdiction of the so-called "Dams Safety Program" to the Commissioner of the Department of Environmental Quality Engineering.

The results of the inspection indicate that this dam is safe; however the following conditions were noted that require attention:

Brush and trees should be removed, one small pine in particular on the westerly end of the dam at the crest of the downstream slope.

We call these conditions to your attention before they become serious and more expensive to correct. With any correspondence please include the number of the Dam as indicated above.

Very truly yours,

DAVID STANDLEY
COMMISSIONER

A.Mc:eh

INSPECTION REPORT - DAMS AND RESERVOIRS

1. LOCATION:

City/Town West Springfield. County Hampden. Dam No. 2-7-325-6.

Name of Dam Bear Hole Reservoir.

Topo Sheet No. 12 A. Mass. Rect. Coordinates: N 413,300, E 279,100.

Inspected by: Harold T. Shumway, On Jan.2,1976. Date Last Inspection Nov.15,1973.

2. OWNER/S: As of January 2, 1976

per: Assessors X, Reg. of Deeds ____, Prev. Insp. X, Per. Contact X.

1. West Springfield Water Dept., 26 Central St., West Springfield, Mass.
Name — St. & No. — City/Town — State — Tel. No.

2. ____
Name — St. & No. — City/Town — State — Tel. No.

3. ____
Name — St. & No. — City/Town — State — Tel. No.

3. CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Carl M. Jacobson
Supt. of West Springfield Water Dept., 26 Central St., West Springfield, Mass.
Name — St. & No. — City/Town — State — Tel. No.

4. DATA:

No. of Pictures Taken none. Sketches See description of Dam.
Plans, Where West Springfield Water Dept. office.

5. DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor ____.
2. Moderate ____.
3. Severe X.
4. Disastrous ____.

Comments: Would flood out pumping station and filter plant ~~directly~~ below dam - plus 2 ea. Town Hwys. and a state hwy., Rte. #20, and a railroad.

*This rating may change as land use changes (future development).

(6.) OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: Westerly end of dam - conc. overflow D.I. sluiceway 12'W.x 26'H.x 50'L. with a 12'x 12' concrete sluice box conduit 127'L.

Controls none, TYPE: _____.

Automatic____. Manual____. Operative Yes____, No____.

Comments: Structure appears sound with no spalling or cracks visible.

No. 2 Location and Type: North or upstream end of sluiceway - 12'W.x 31'H.x 13'L.concrete controll well with a 21'long intake structure.

Controls yes, Type: 2 Ea.16" gate valves - 1 ea.6" gate valve - 1 ea 2½'x 3' slide gate.

Automatic____. Manual X. Operative Yes X, No____.

Comments: Top edges of conc. control well slightly spalled -all controls in working order per Water Dept. personnel.

No. 3 Location and Type: West side and upstream wall of control well - 5½'W. x 1½'W. opening.

Controls yes, Type: Steel slide gate.

Automatic____. Manual X. Operative Yes X, No____.

Comments: Gate in good condition.

Drawdown present Yes X, No____. Operative Yes X, No____.
Comments: 2½'x 3' slide gate is a drawdown gate. See item #2 above.

(7.) DAM UPSTREAM FACE: Slope 2½:1, Depth Water at Dam 12'out from shore is 6' to 7' deep.

Material: Turf X. Brush & Trees____. Rock fill____. Masonry____. Wood____.

Other Stone rubble paving.

Condition: 1. Good____. 3. Major Repairs____.

2. Minor Repairs X. 4. Urgent Repairs____.

Comments: Minor brush growth on upstream slope.

(8.) DAM DOWNSTREAM FACE: Slope 3:1.

Material: Turf X. Trees X. Rock Fill____. Masonry____. Wood____.

Other _____.

Condition: 1. Good X. 3. Major Repairs____.

2. Minor Repairs____. 4. Urgent Repairs____.

Comments: Lower portion of slope set out with pine trees - 2" to 4" dia. 1 ea. 2" or 3" pine on top edge of downstream slope.

(9.) EMERGENCY SPILLWAY: Available No . Needed No .

Height Above Normal Water_____Ft.

Width_____Ft. Height_____Ft. Material_____

Condition: 1. Good_____. 3. Major Repairs_____.

2. Minor Repairs_____. 4. Urgent Repairs_____.

Comments: Overflow sluice box has been adequate since built in 1956.

(10.) WATER LEVEL AT TIME OF INSPECTION: 1/6 Ft. Above X . Below_____.

Top Dam_____ F.L. Principal Spillway X_____.

Other_____.

Normal Freeboard 7½' to 8 Ft.

(11.) SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment 1 ea.2" to 3" pine tree at crest of downstream slope on westerly end of dike. Minor brush growth on upstream slope.

Animal Burrows and Washouts None found.

Damage to Slopes or Top of Dam None found.

Cracked or Damaged Masonry Minor spalling of concrete structure on top edge.

Evidence of Seepage Seepage flows noted in rock blanket on easterly side of conc. box conduit on downstream slope.

Evidence of Piping None found.

Leaks None found

Erosion None found.

Trash and/or Debris Impeding Flow None found.

Clogged or Blocked Spillway None.

Other_____.

(12.) OVERALL CONDITION:

1. Safe_____.
2. Minor repairs needed X .
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list_____.

(13.) REMARKS AND RECOMMENDATIONS: (Fully Explain)

Grade and alignment of dam appeared good. Slopes did not appear to have been mowed this year and a light growth of brush was noted on upstream slope. Flows were noted emerging from rock blanket on downstream slope but these flows were minimal and normal for this type of constructed dike. Water Dept. personnel stated that in dry months of summer these flows disappear entirely.

The concrete structures all appeared sound and the 12' x 12' concrete sluice box conduit interior has been refaced since last inspection. No leaks or seepage were found inside of box. All controls appeared to be in good order and all are operable per Water Dept. personnel.

One small pine, 2" to 3" in diameter and about 5 feet tall was noted growing on westerly end of dam at crest of downstream slope. This tree could become a hazard in future years as top of dam is only 14 feet wide.

Dam appears safe at time of inspection.

HTS/bk

OL FILE

INSPECTION REPORT - DAMS AND RESERVOIRS

1. LOCATION:

City/Town West Springfield. County Hampden. Dam No. 2-7-325-6.

Name of Dam Bear Hole Reservoir.

Topo Sheet No. 124. Coordinates: Mass. Rect. N 413,300, E 279,100.

Inspected by: H. T. Shumway, On Nov. 15, 1973. Date Last Inspection 1970.

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2. OWNER/S: As of November, 1972

per: Assessors X, Reg. of Deeds ____, Prev. Insp. ____, Per. Contact X.

1. West Springfield Water Department
Office of Superintendent, Piper Road, West Springfield, Mass.
Name | St. & No. | City/Town | State | Tel. No.

2. ____
Name | St. & No. | City/Town | State | Tel. No.

3. ____
Name | St. & No. | City/Town | State | Tel. No.

---

3. CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Carl M. Jacobson
Supt. of W. Springfield Water Dept. 26 Central St. W. Springfield 781-7550 ext. 245 or 253
Name | St. & No. | City/Town | State | Tel. No.

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4. DATA:

No. of Pictures Taken None. Sketches See description of Dam.
Plans, Where at West Springfield Water Department Office.

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5. DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor ____.
2. Moderate ____.
3. Severe X.
4. Disastrous ____.

Comments: Complete failure would wash out pumping station and filter plant.

*This rating may change as land use changes (future development). Directly below dam, plus 2 Town Highways and possibly Rte. 20, a State Highway, plus damage to railroad.

(6.) OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: Westerly end of dam a concrete overflow drop inlet sluicebox 12'W. x 12'H. x 190'Long. Plus a 21'Long intake basin.

Controls No, TYPE: _____.

Automatic____. Manual____. Operative Yes____, No____.

Comments: 30' of north end of sluice has overflow sidewalls 26'± High above floor of sluicebox plus a 13'L x 12'W. x 31'H. control well on end of sluice.

No. 2 Location and Type: At north end of sluicebox concrete control well 13' x 12' x 31'

Controls Yes, Type: Screw lift sluice gate 2' - 6"W. x 3' - 0"H. _____.

Automatic____. Manual X. Operative Yes X, No____.

Comments: This sluicegate is draw-down gate. _____.

No. 3 Location and Type: In east side and northeast end of control well _____.

Controls Yes, Type: Two 16" sluice gates with screw lifts - See sketch sheet #3

Automatic____. Manual X. Operative Yes X, No____.

Comments: All controls operable per Water Department personnel. _____.

Drawdown present Yes X, No____. Operative Yes X, No____.
Comments: See No. 2 above. _____.

(7.) DAM UPSTREAM FACE: Slope 2½:1 _____, Depth Water at Dam 6' deep out 12'. from shore.

Material: Turf X. Brush & Trees____. Rock fill____. Masonry____. Wood____.

Other Stone rubble paving _____.

Condition: 1. Good X. 3. Major Repairs_____.

2. Minor Repairs_____. 4. Urgent Repairs_____.

Comments: Slope appeared stable and of good alignment at time of inspection. Grass and weeds had not been cut. _____.

(8.) DAM DOWNSTREAM FACE: Slope 3:1 _____.

Material: Turf X. Brush & Trees____. Rock Fill____. Masonry____. Wood____.

Other _____.

Condition: 1. Good X. 3. Major Repairs_____.

2. Minor Repairs_____. 4. Urgent Repairs_____.

Comments: Heavy weed and grass growth uncut but this condition no hazard to slope at this time.

(9.) EMERGENCY SPILLWAY: Available No. Needed No.

Height Above Normal Water _____ Ft.

Width _____ Ft. Height _____ Ft. Material _____.

Condition: 1. Good _____. 3. Major Repairs _____.

2. Minor Repairs _____. 4. Urgent Repairs _____.

Comments: This sluicebox has carried high water run-offs since it was built in 1956.

(10.) WATER LEVEL AT TIME OF INSPECTION: 1 Ft. Above _____. Below X.

Top Dam _____ F.L. Principal Spillway _____.

Other Top of west overflow wall of sluiceway.

Normal Freeboard 7½ Ft.±

(11.) SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment Heavy weed & grass growth uncut.

Animal Burrows and Washouts None found

Damage to Slopes or Top of Dam None found

Cracked or Damaged Masonry Minor spalling of concrete on interior walls of spillway

Evidence of Seepage Seepage noted coming through concrete spillway at const. joint. Yes - seepage at southeast toe of channel slope also seepage noted at end of conc. encasement of raw water pipe line.

Evidence of Piping None found

Leaks None found

Erosion None found

Trash and/or Debris Impeding Flow None

Clogged or Blocked Spillway None

Other _____.

(12.) OVERALL CONDITION:

1. Safe X .
2. Minor repairs needed _____ .
3. Conditionally safe - major repairs needed _____ .
4. Unsafe _____ .
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list _____ .

(13.) REMARKS AND RECOMMENDATIONS: (Fully Explain)

The grade and alignment of this dike appears good. The concrete structure appears sound with only minor spalling noted on inner wall surfaces of sluicebox. Some seepage was noted in top of sluicebox at an expansion joint on northerly side of dike.

It was noted that the width of top of dike was only 14 feet instead of 20 feet as shown on plans on file. Also, it was noted that elevation of top of dike appeared to be 2'±, higher in relation to elevations of concrete structure than what was shown on plans on file in Water Department Office. This is probably due to construction of road on top of dam after completion of dam.

This dam was completely rebuilt in 1956 and 1957 after loss of old dam in 1955 flood. The sluicebox under the dike is a 12' x 12' concrete conduit and has proved adequate to date to carry high water run-offs.

The weeds and grass growth on slopes have not been mowed but this is of no hazard to dam slopes.

The downstream slope is well turfed and appears stable. The upstream slope is stone rubble paved to within 6 feet of the top of dike and turfed over on this last 6 feet.

Dike and concrete structure appears safe at time of inspection.

RCS/js /rt

DESCRIPTION OF DAM

DISTRICT 2.

Submitted by H. T. Shumway Dam No. 2-7-325-6

Date November 15, 1973 City/Town West Springfield

Name of Dam Bear Hole Reservoir

1. Location: Topo Sheet No. 12A Mass. Rect. Coordinates N 413,300 E 279,100

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

Right of Bear Hole Road "Great Plains Road approximately ½ mile northwesterly from Dewey Street at West Springfield Water Works about ½ mile from Bear Hole Road.

2. Year built 1956 Year/s of subsequent repairs Unknown

3. Purpose of Dam: Water Supply X Recreational _____
Flood Control _____ Irrigation _____ Other _____

4. Drainage Area: 5.5 sq. mi. _____ acres.
Type: City, Bus. & Ind. _____ Dense Res. _____ Suburban _____ Rural, Farm _____
Wood & Scrub Land X Slope: Steep ½ Med. ½ Slight _____.

5. Normal Ponding Area: 25 Acres; Ave. Depth 8' to 9' (maximum depth 27' per W. Spfld. W.D.)
Impoundment: 63 million gals.; 200+ acre ft.
Silted in: Yes _____ No X Approx. Amount Storage Area _____

6. No. and type of dwellings located adjacent to pond or reservoir _____
i.e. summer homes etc. Pumping Station & water treatment plant below dam.

7. Dimensions of Dam: Length 250'± Max. Height 34'
Freeboard 7' - 6"
Slopes: Upstream Face 2:1
Downstream Face 3:1
Width across top 14' (12' paved)

Dam No. 2-7-325-6

8.

Classification of Dam by Material:

Earth X Conc. Masonry X Stone Masonry _____

Timber _____ Rockfill _____ Other Stone Paving

8A.

Dam Type: Gravity X Straight X Curved, Arched _____ Other _____

Embankment Overflow _____ Non-overflow X

9.

A. Description of present land usage downstream of dam:

100 % rural; _____ % urban

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? Yes _____ No X

C. Character Downstream Valley: Narrow 85% Wide 15% Developed 2%

Rural 98% Urban _____

10.

Risk to life and property in event of complete failure.

No. of people 1

No. of homes 1

No. of businesses None

No. of industries None Type _____

No. of utilities 5 Type Telephone, Electric, Gas, Sewer, and water lines Town Water Supply

Railroads 1 - Penn Central

Other dams 1

Other 2 Town Highways and 1 State Highway (Route #20)

11.

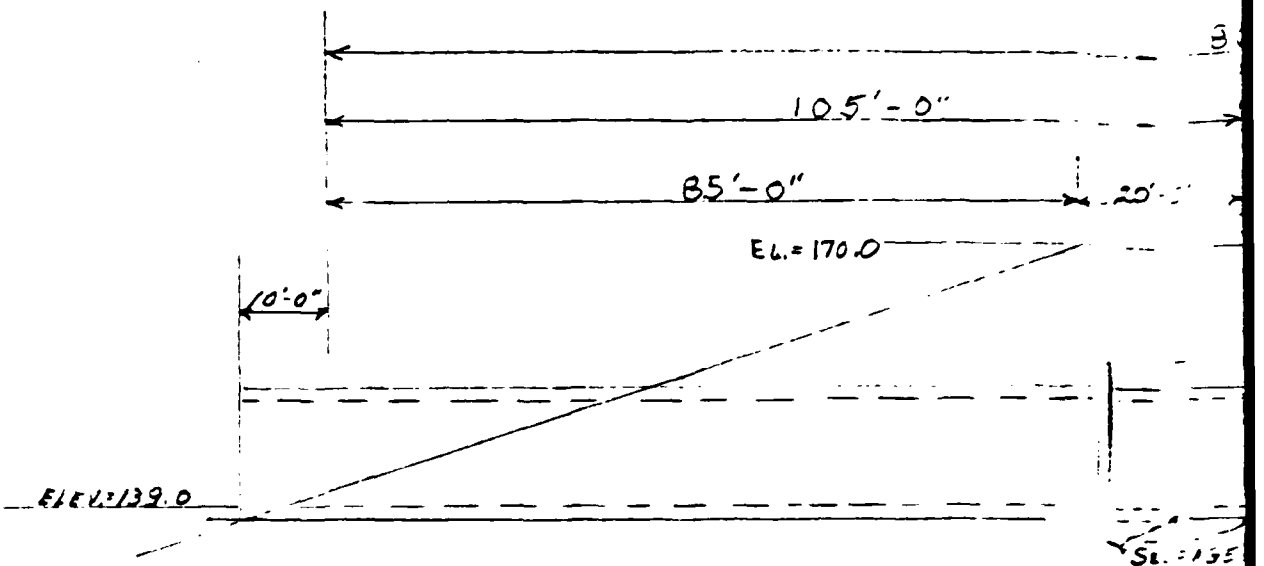
Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

RCS/vk/rt

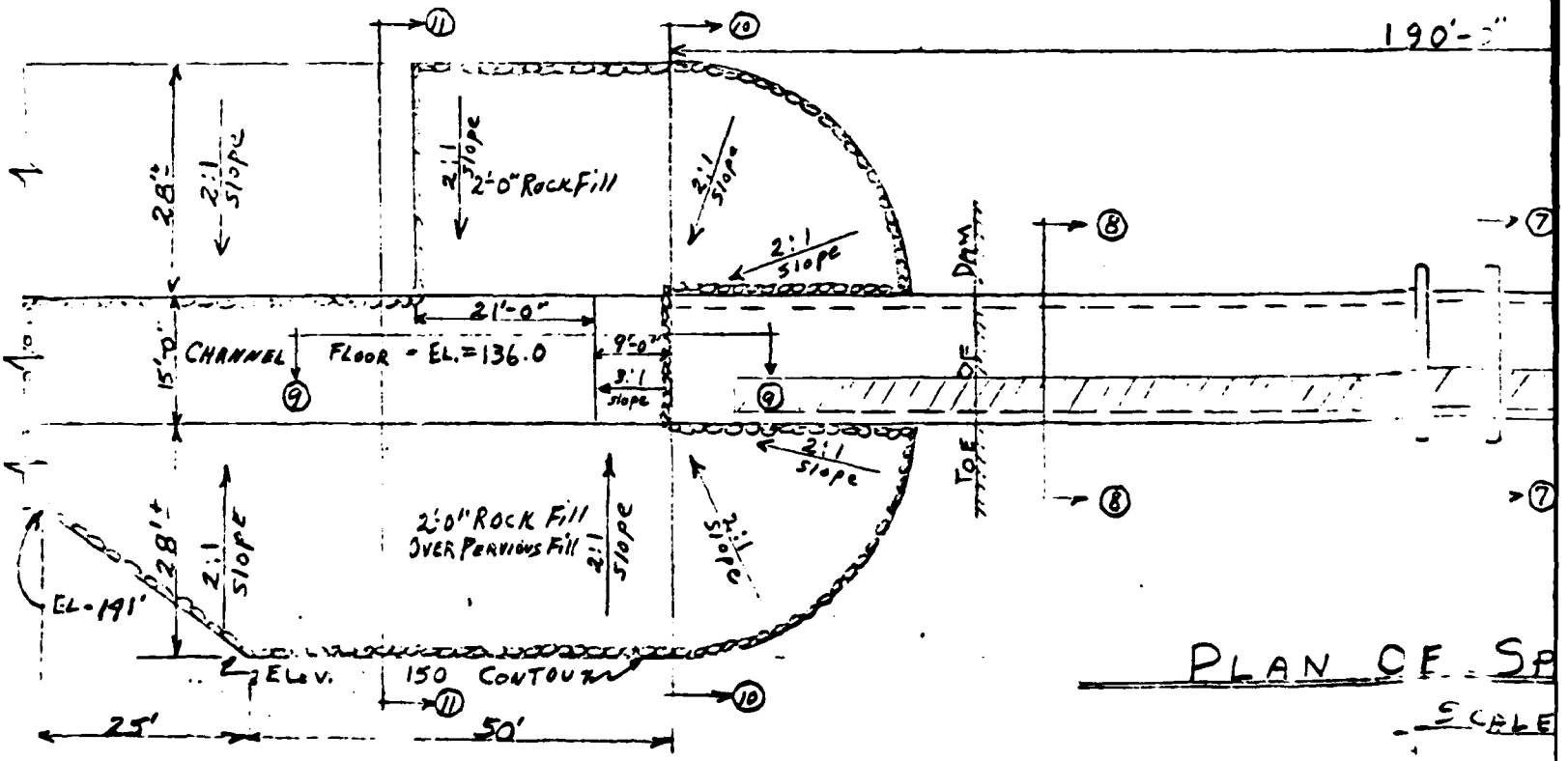
Attachments

Locus Plan

Sketches



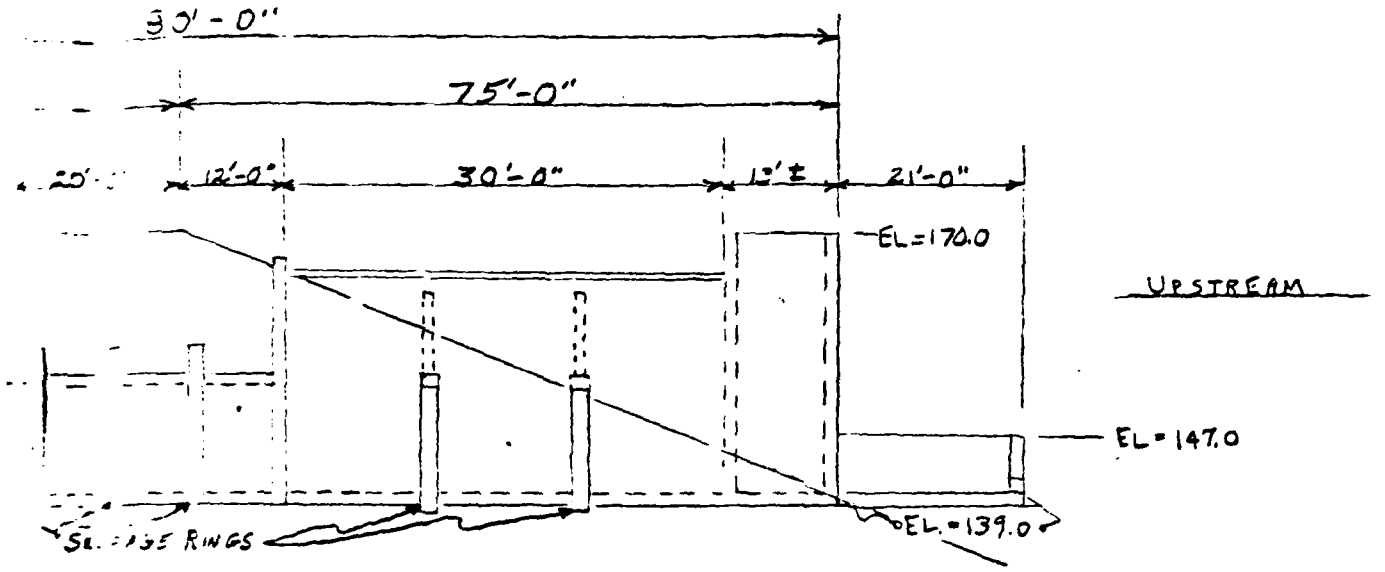
SIDE ELEVATION



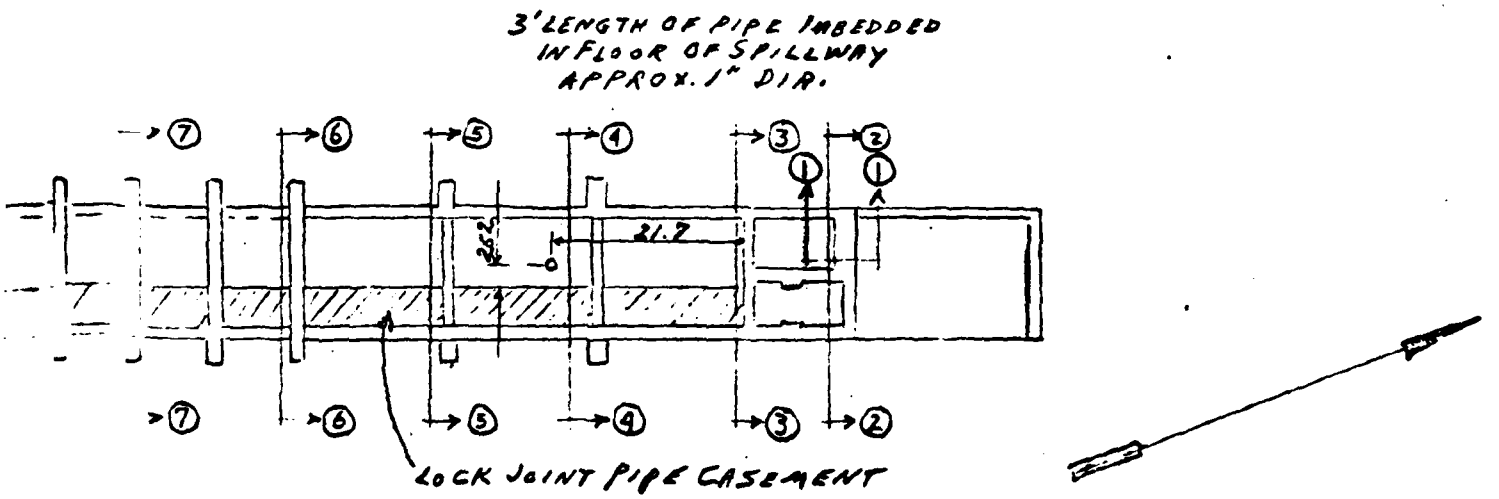
PLAN OF SP

SCALE

BEAR HOLE RESERVOIR DAM
DAM No. 2-7-325-6
West Springfield, Mass.
Sheet # 1 of 3 Sheets



VATION (EAST) OF SPILLWAY STRUCTURE
SCALE • 1" = 20'-0"



OF SPILLWAY STRUCTURE
SCALE = 1" = 20'-0"

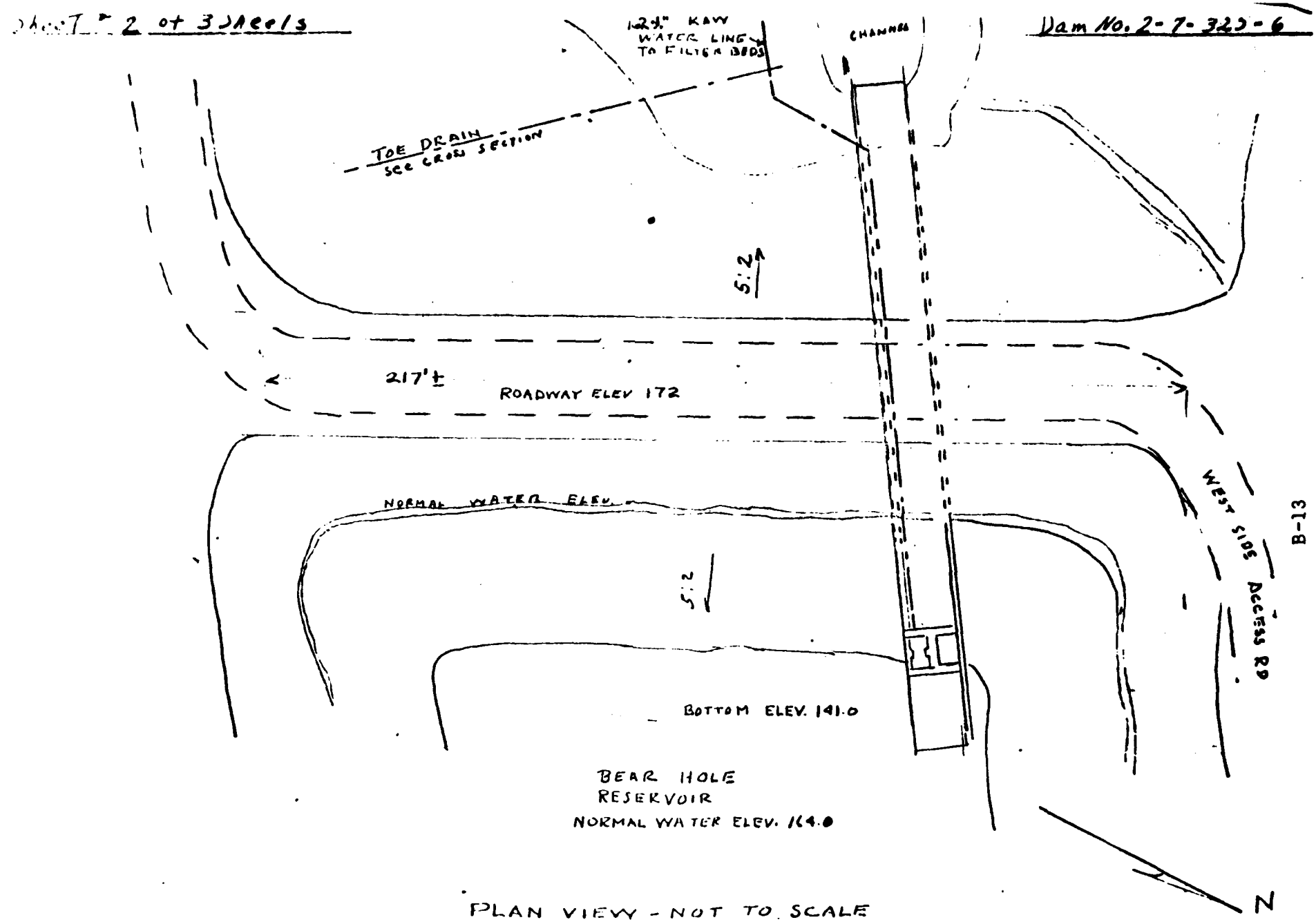
Copied from plans in
West Springfield Water Dept. Office.
Bear Hole Dam
Plan sheet #11 dated 1956
Tighe & Bond Consulting Eng.

2

N.T.S.

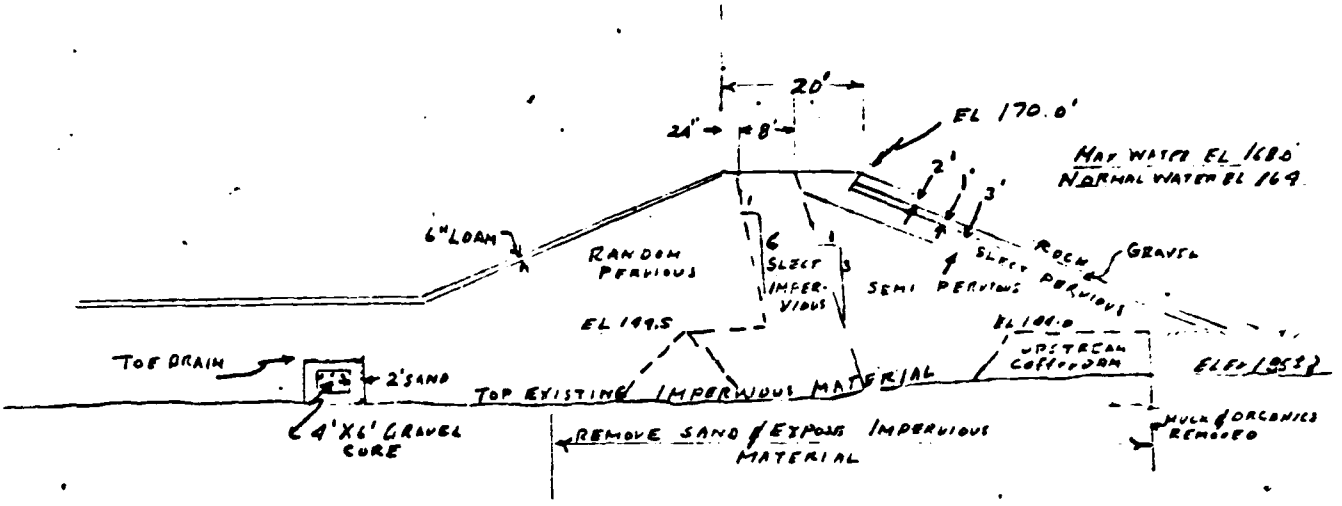
Sheet No. 2 of 3 Sheets

Dam No. 2-7-323-6

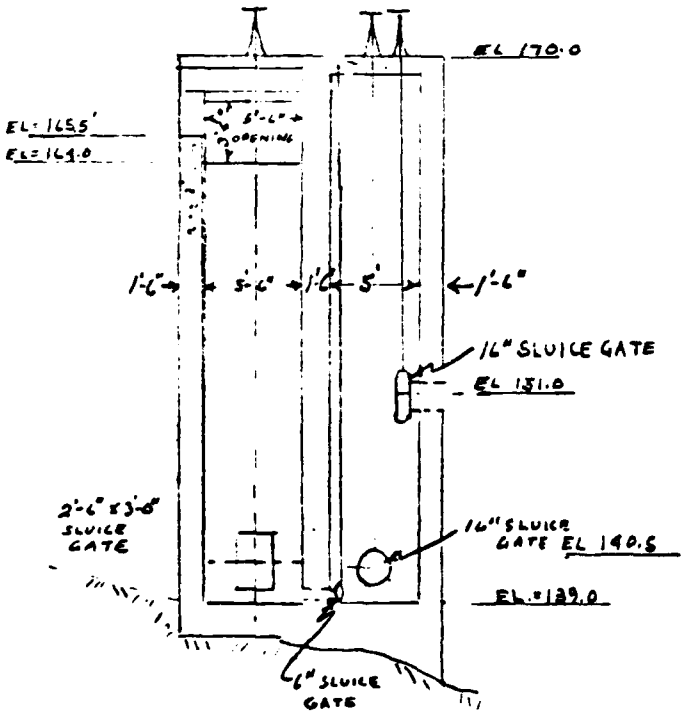


PLAN VIEW - NOT TO SCALE

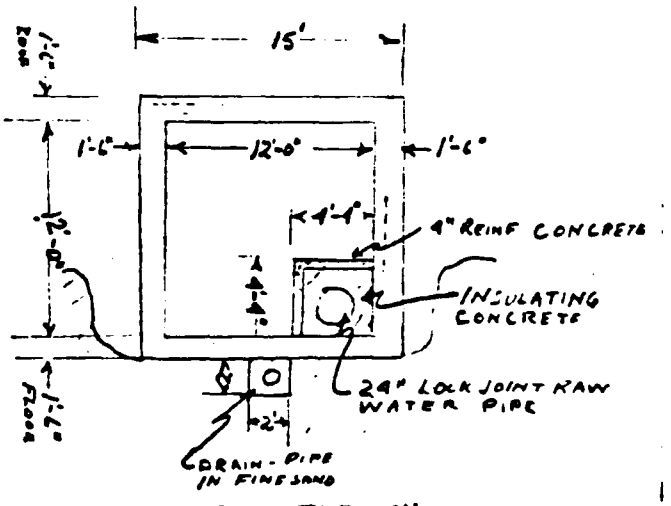
B-13



TYPICAL X SECTION THROUGH
ENBANKMENT - FROM
RECORD PLANS
DATED MAY 1956

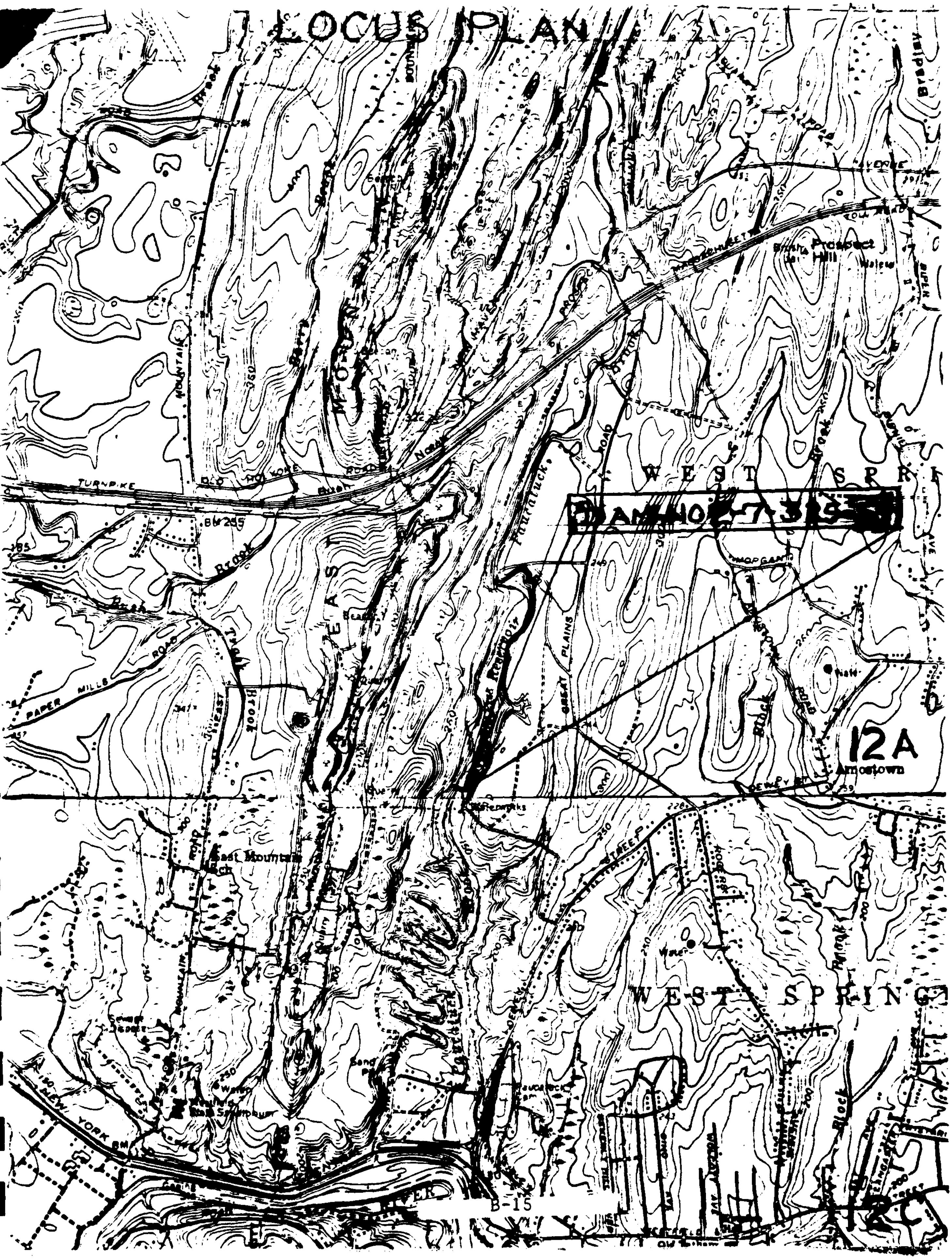


X SECTION THROUGH
INTAKE WELL & DROP
INLET FOR SPILLWAY
SECTION 22



X SECTION THROUGH
SPILLWAY REINF. CONCRETE
CONDUIT
SECTION NO 8 B

R.C.S.
11-14-73


LOCUS PLAN
TURNPIKE
PAPER MILLS ROAD
WEST SPRI
WEST SPRING
12A
Amostown
East Mountain
Prospect Hill
NEW YORK

TIGHE & BOND CONSULTING ENGINEERS

DAMS IN HAMPDEN COUNTY, MASSACHUSETTS

WEST SPRINGFIELD

1. Strathmore Paper Company Dam

   Strathmore Paper Company, West Springfield, Mass.

2. Country Club Dam

   Springfield Country Club, 1375 Elm Street, West Springfield, Mass.

3. Lyncosky Dam - Upper Dam

   Mr. Fred Lyncosky, 573 Piper Road, West Springfield, Mass.

4. Lyncosky Dam - Lower Dam

   Mr. Fred Lyncosky, 573 Piper Road, West Springfield, Mass.

5. Piper Reservoir Dam

   Town of West Springfield, Town Office, West Springfield, Mass.

6. Bear Hole Dam

   Office of the Superintendent, West Springfield Water Department, Piper Road, West Springfield, Mass.

The last routine inspections of all dams located within the Town of West Springfield were conducted in July of 1970. A letter-report on the conditions noted at each of the dams was sent to the Board of County Commissioners on July 27, 1970.

Of all of the dams inspected, only one required any comment regarding maintenance. This was the Strathmore Paper Co. Dam located in Westfield River just upstream of the paper mill in West Springfield.

A copy of my report to the Commissioners of Hampden County is attached hereto for your information and file. In that letter-report under Section B, you will note two dams in Mitteneague Park. These are being dropped from the inspection list since they are so small and have been abandoned by the Park Department. They have only been on the inspection list because of the

THE BOND CONSULTING ENGINEERS

size of the drainage area involved. There is no further need for inspecting these two small dams in Mitteneague Park.

George H. McDonnell
County Hydraulic Engineer
Hampden County

DONNELL
ERIDAN
BAYON

TIGHE
& BOND CONSULTING ENGINEERS

CIVIL SANITARY AND ELECTRICAL ENGINEERING
INVESTIGATIONS REPORTS PLANS AND SPECIFICATIONS
SUPERVISION OF CONSTRUCTION AND OPERATION

BOWERS AND PEQUOT STREETS
HOLYOKE, MASSACHUSETTS
TEL. JEFFERSON 3-3991

CD West Springfield
July 27, 1970

The Honorable the Board of County Commissioners
52 State Street
Springfield, Massachusetts

Gentlemen:

Each dam located within the Town of West Springfield has been inspected at least once during the year 1970. Inspections were made from time to time, with the final inspection being made on July 17, 1970. The follow-int is a report on the condition noted at each of the dams located within the Town of West Springfield.

A. Strathmore Paper Co. Dam

The abutment areas at this dam are in fair condition. However, the old log crib and plank dam is only in fair condition. The crest sags at two locations, probably the result of settlement and crushing of some of the old logs and timbers forming the crib construction. Leakage was observed at a number of places along the toe area of the dam.

The volume of storage in the stream behind the dam is not very great since much of the volume has been filled in with material washed down from upstream and other material used for coffer dam construction in the past when repairs were made to the crib dam.

The repaired section of the dam located at the left end appears to be holding up fairly well.

The canal headworks were observed to be in satisfactory condition. The head gate openings were wide open and river water flowed into the canal as well as over the crest of the dam at the location of the

two sag areas. One of the canal drawdown gates was partly open and water discharged from the canal. The canal spillway was in fair condition.

Water level flowing in the canal was below normal elevation, probably as a result of a lowered elevation of the pond behind the dam due to discharge of water over the crest of the dam thru the two sag locations.

It is possible that a failure in the dam could occur again as has been experienced in the past. A failure of this sort will not endanger persons and property downstream since the amount of water that would be released could be handled very easily in the stream bed. The stream bed below the dam is quite wide and dry.

The only danger to any such failure would come about if a person happened to be in the bed of the stream directly in the front of the timber crib dam when failure of a section occurred.

In the opinion of the undersigned, the owner of the dam should make frequent inspections of the dam and if there is evidence that further settling and crushing is occurring, steps should be taken to repair that portion of the timber crib dam that is affected.

B. Mittineague Park Dams

Upper Dam

The drainpipes were found to be open at this small dam and no water was stored. The pond volume behind the dam has been completely filled up with silt and earth washed in from upstream. The masonry top section of the spillway is o.k. but the cobblestone masonry at the base of this small dam and the cemented cobblestone apron were noted to be eroded, broken and in poor condition.

Since this dam stores an insignificant quantity of water and since failure of this small dam could not do any damage to persons and property downstream, no further inspections will be made of this dam unless the undersigned is advised to the contrary.

Lower Dam

This dam is inactive and the drainpipe is open. Masonry construction forming the dam is in fair condition.

As in the case of the Upper Dam, little or no water is stored by this Lower Dam and much of the pond volume has been filled in by material washed in from upstream.

The dam stores such a small quantity of water and since the depth of the pond is extremely shallow, the dam does not endanger persons and property downstream.

As mentioned in my report of a year ago, this dam will be dropped from the inspection schedule unless the undersigned is advised to the contrary. I see no further need for inspecting this small dam in Mittineague Park.

C. Country Club Dam

The embankment forming this dam was in good condition. The toe area was found to be dry. The turf surfaces on the slopes and at the edges of the roadway along the embankment were in good condition.

The old spillway facility was operating and water level in storage was at the top of the upper stoplog. The masonry of the old spillway is in fair condition. Some debris was in the spillway inlet but the condition is not dangerous.

The flood flow spillway shaft was in good condition. The tube was examined from end to end and found to be o.k.

The first joint in the tube thru the embankment located upstream from the portal end of the tube shows signs of opening and failure of the joint repair work. The condition is o.k. for now but in another year it is possible that this joint may need repair work again. All joints in the flood flow spillway tube should be checked carefully in 1971 and any repair work needed at that time should be done by the owner of the dam.

The stone filled toe area at the spillway outlet was in good condition.

No changes have been made at this dam since the time of the previous inspection and the structure was considered to be safe when checked.

D. Lyncosky Dams

Upper Dam

This small dam is in the same general condition as reported each year. As mentioned previously, it is my opinion that the dam does not come under County jurisdiction, but since it is directly upstream of the Lower Dam and, since it carries the access road to the Lower Dam, a report is submitted on the general condition of the Upper Dam.

The paved roadway and the embankment fill were observed to be in satisfactory condition. The embankment is quite shallow in height for its relatively large width. Even if high rates of surface runoff should exceed the capacity of the small spillway tube thru the upper dam embankment, excess flow would pass over the dam embankment and cross the roadway without doing any substantial damage to the dam.

In the opinion of the undersigned, this dam is in satisfactory condition.

Lower Dam

The embankment forming this dam is fairly well shaped and has a good growth of turf on its top. Side slopes are weed covered and there is a fairly heavy brush growth along the toe area.

Water level in storage was at the crest of the masonry overflow. The spillway inlet structure was o.k. There were no stoplogs or flashboards on the crest. The spillway screen was in place and it was clean. There was no debris in the spillway inlet.

The outlet area of the spillway is rather dilapidated but it is serviceable.

No changes have been made at this dam since the time of the last inspection, and in the opinion of the undersigned, the dam is safe.

E. Piper Reservoir Dam (new Swimming Pool Dam)

The embankment forming this dam was satisfactory as to shape. The turf cover is very poor. In fact, it is almost non-existent. In spite of the fact that there is little or no turf cover, there is

very little evidence of any erosion on the surface of the embankment.

The spillway shaft was in satisfactory condition and water level in storage was at the crest of the hole thru the concrete wall of the shaft.

The tube spillway thru the embankment was o.k. There was no debris in the spillway pipe. The outlet end of the spillway was satisfactory.

In years past, this dam formed a body of water that was used for swimming purposes. However, the Town of West Springfield has since built an artificial swimming pool on the left bank of the stream just above the dam and all swimming is now done in this artificial concrete, standard-type municipal pool. Little or no use is now made of the dam and the pond formed by the dam.

In the opinion of the undersigned, the Piper Reservoir Dam is in satisfactory condition and it is safe.

F. Bear Hole Dam

The spillway masonry at this dam was noted to be in good condition. On the day of inspection water level in storage was at the crest of the low side wall of the spillway structure. There were no flashboards on the side wall crests. The normal small metal stoplog plate was in the slots at the upper end of the spillway structure.

The walkway bridge out over the spillway was o.k.

The embankment was found to be in satisfactory condition. The gravel road along the top of the embankment was satisfactory. The toe areas of the embankment, one on each side of the spillway conduit outlet, were in good condition. Seepage was noted on each side of the conduit portal. The largest amount of seepag e was observed on the left side. This is a normal condition.

The amount of seepage observed was about the same as noted in the past. There is no evidence of any movement of soil particles with the seepage water.

The rock filled toe area of the embankment was in good condition.

[redacted] CONSULTING ENGINEERS

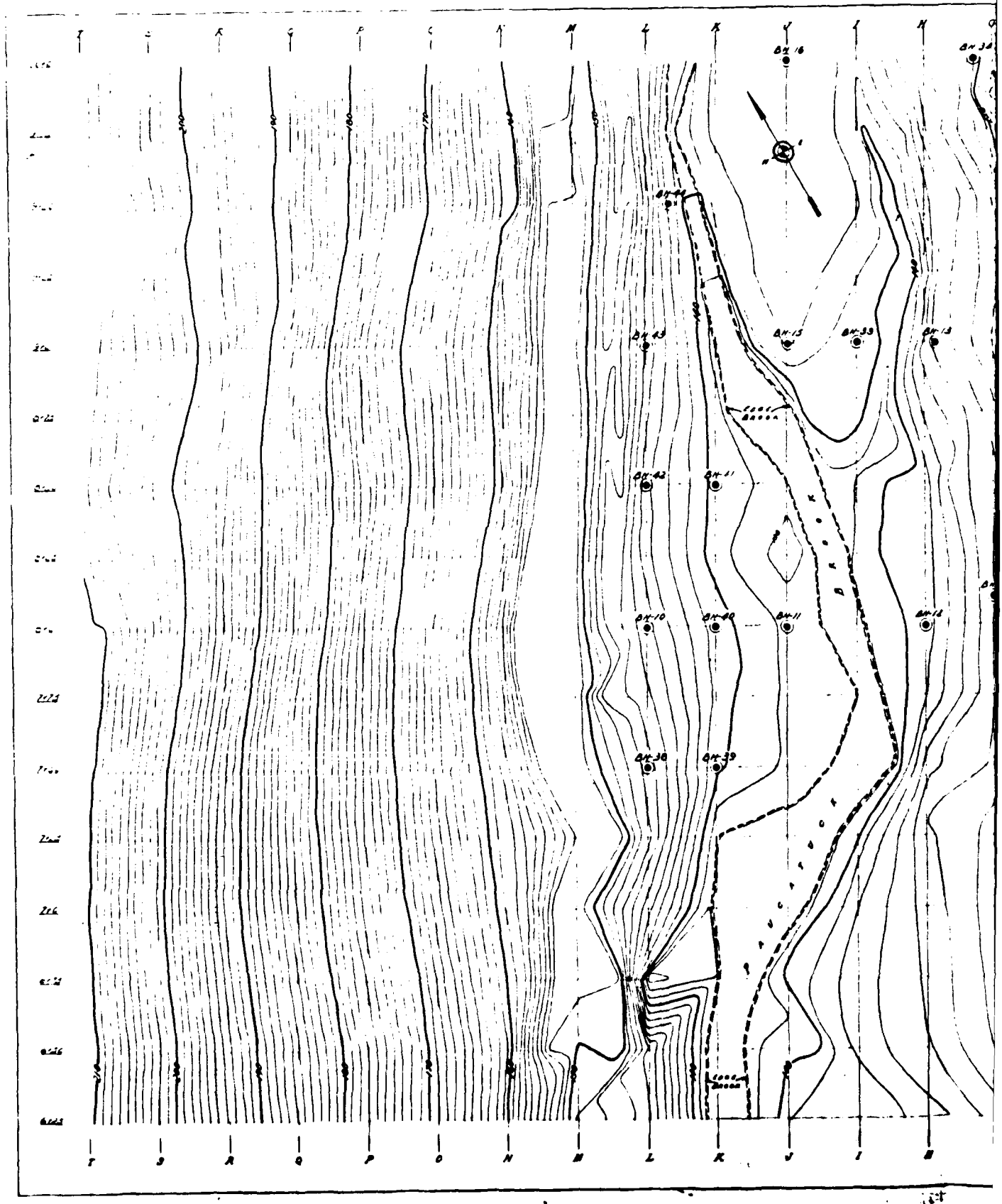
The downstream slope of the embankment has very little turf cover. It is mostly weeds. There are areas of the embankment surface where there is no vegetation growth at all. However, no erosion was observed on these areas.

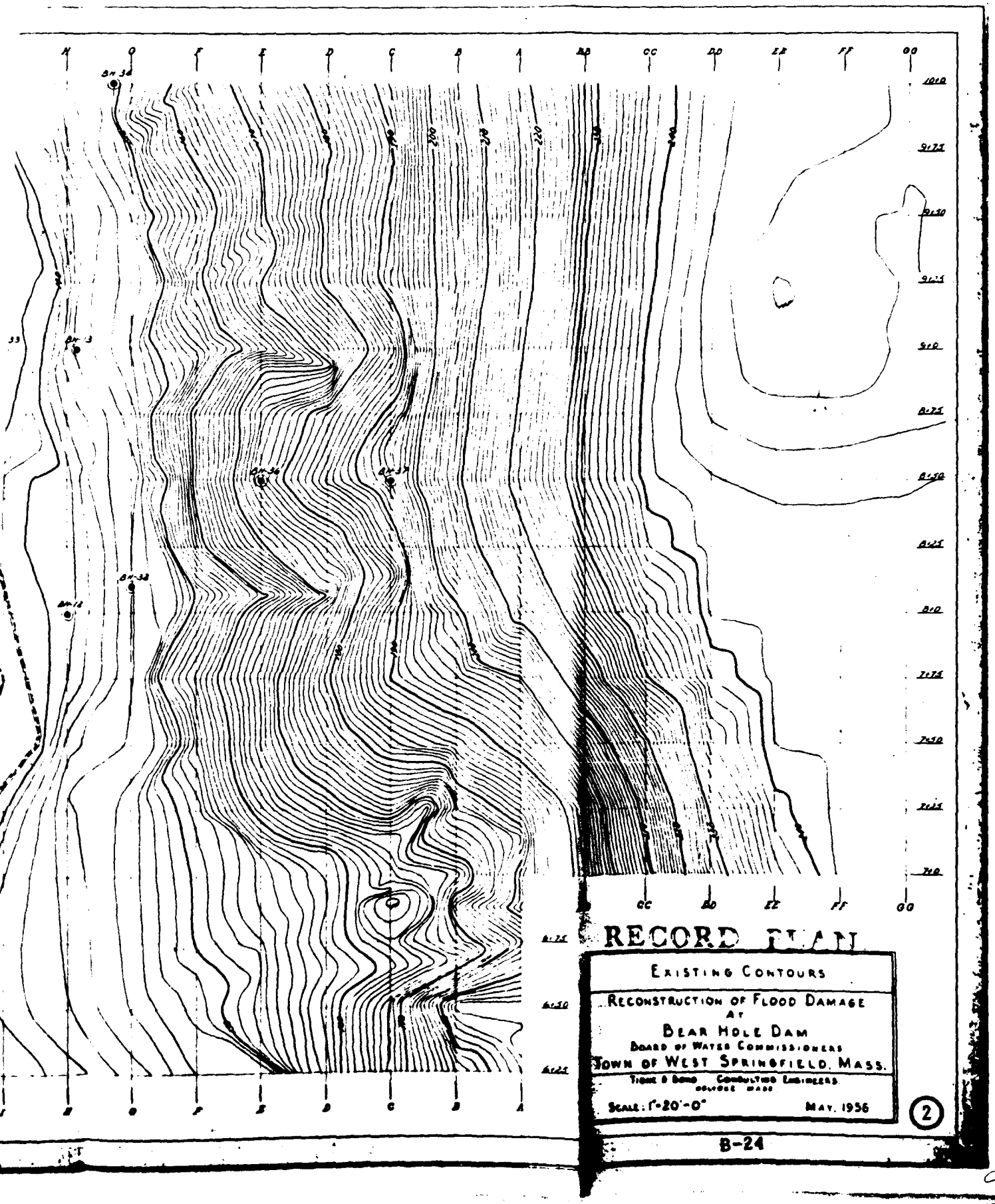
In the opinion of the undersigned, the dam is in good condition and it is safe.

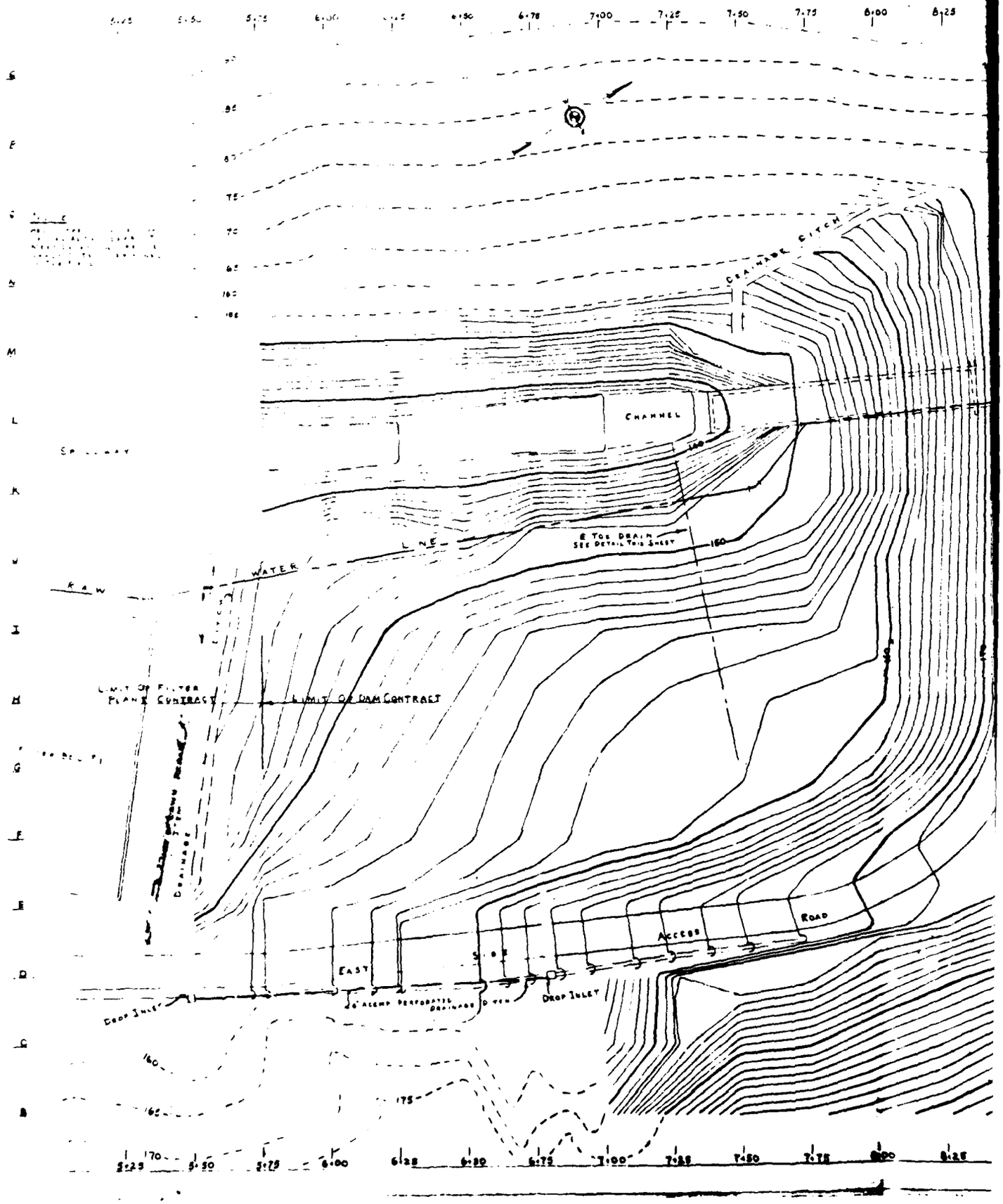
Respectfully submitted,

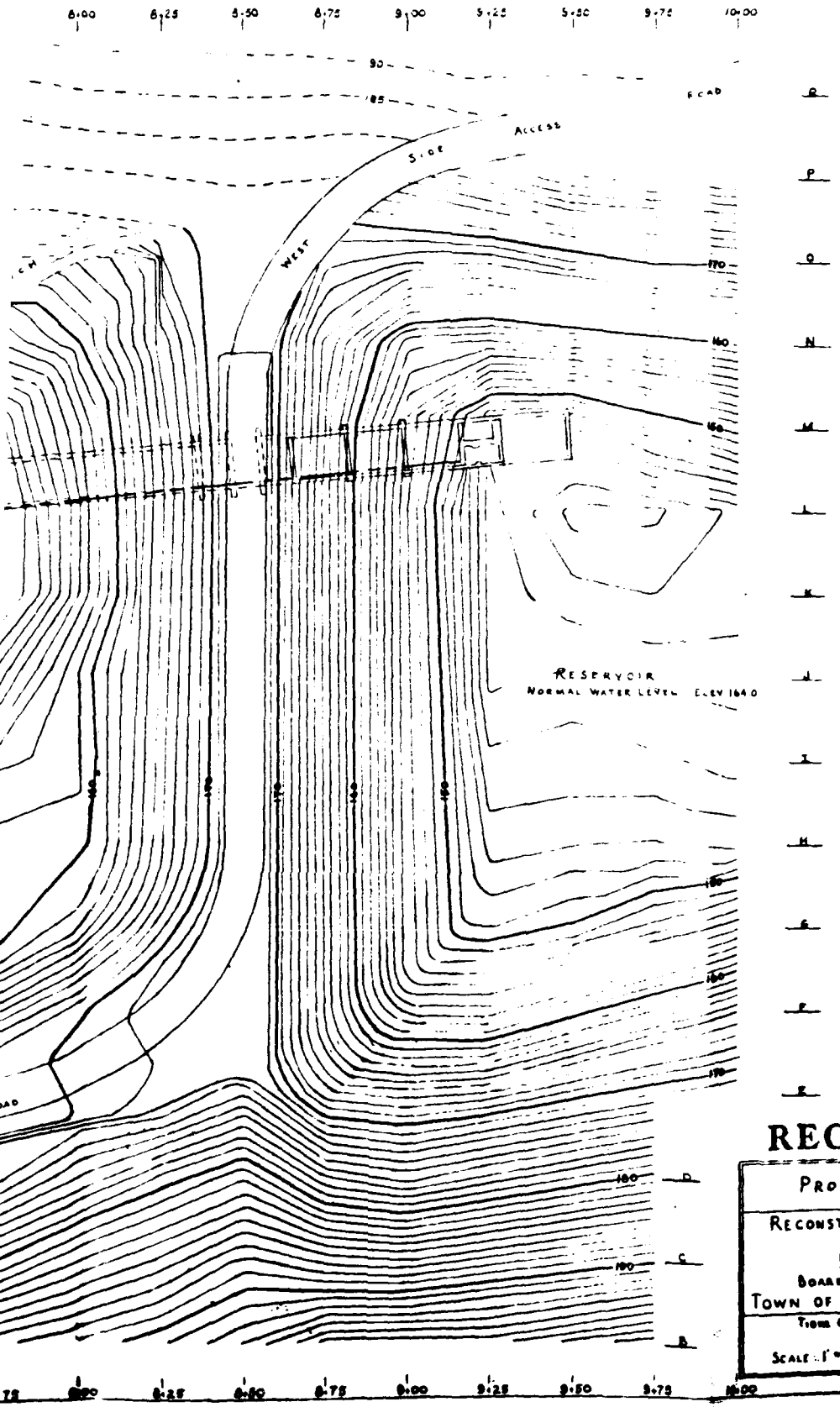
George H. McDonnell
County Hydraulic Engineer

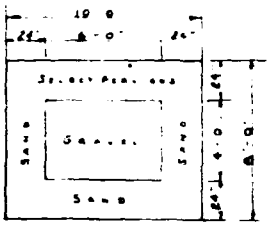
GHM/amd


BH-16
BH-14
BH-43
BH-13
BH-33
BH-42
BH-41
BH-10
BH-40
BH-11
BH-12
BH-38
BH-39
BARRACK


RECORD PLAN
EXISTING CONTOURS
RECONSTRUCTION OF FLOOD DAMAGE
AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS.
TIGHE & BOND CONSULTING ENGINEERS
HOLYOKE MASS
SCALE: 1"-20'-0"
MAY, 1956
2
B-24


DRAINAGE DITCH
CHANNEL
SPILLWAY
WATER LINE
RAW
8" TOE DRAIN
SEE DETAIL THIS SHEET
LIMIT OF FILTER PLANT CONTRACT
LIMIT OF DAM CONTRACT
ACCESS ROAD
EAST
DROP INLET
DROP INLET





TYPICAL SECTION TOE DRAIN
SCALE 1/4"=1'-0

RECORD PLAN

PROPOSED DEVELOPMENT

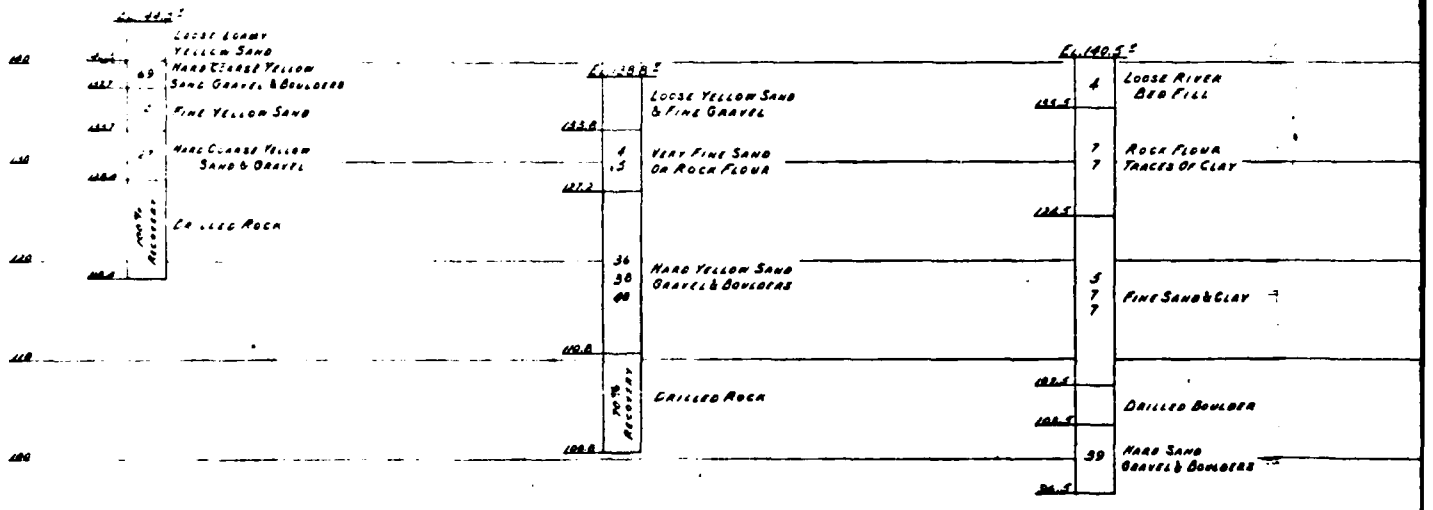
RECONSTRUCTION OF FLOOD DAMAGE
AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS.

TIGHE & BOND CONSULTING ENGINEERS
WESTFIELD, MASS

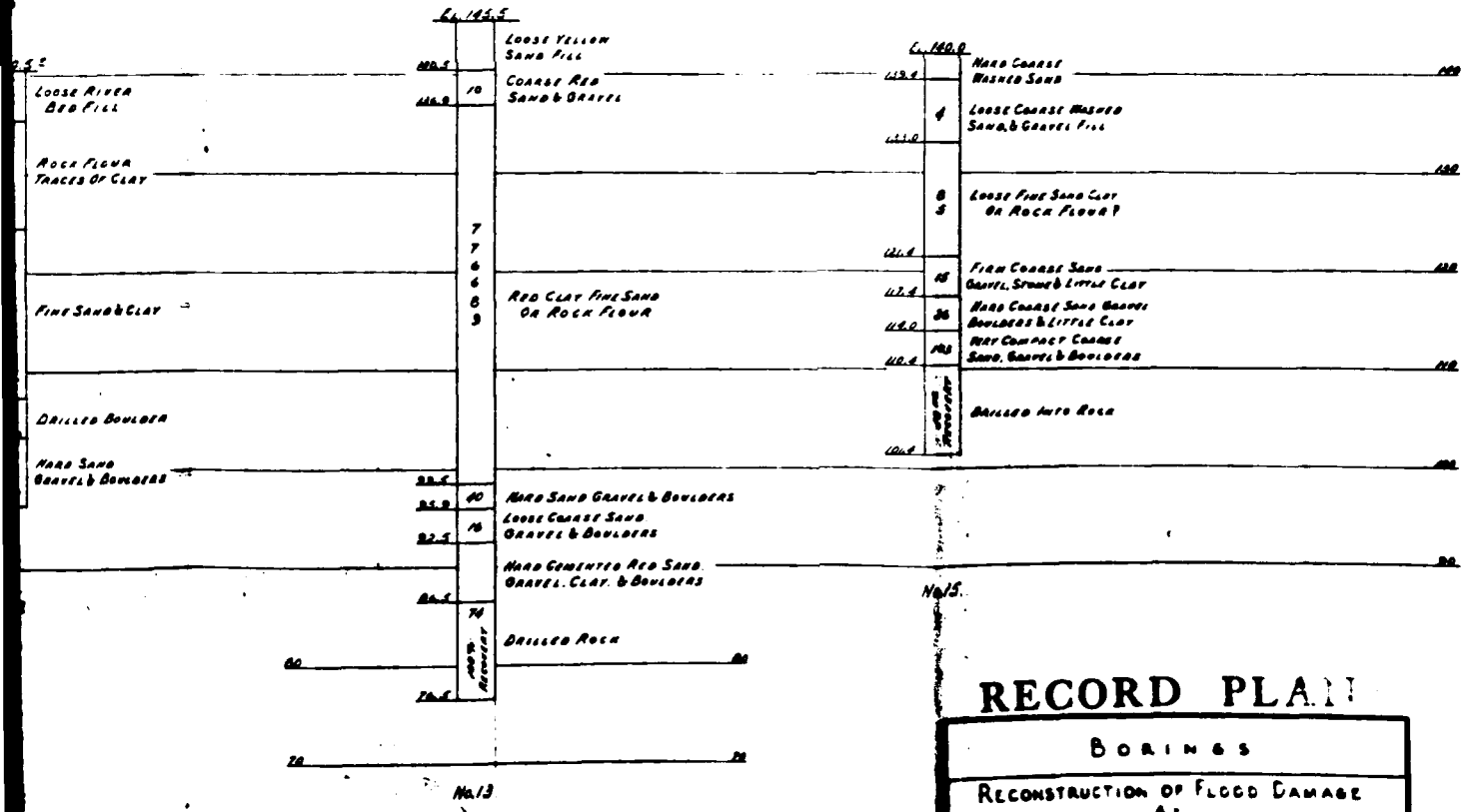
SCALE: 1"=20'-0" MAY, 1956

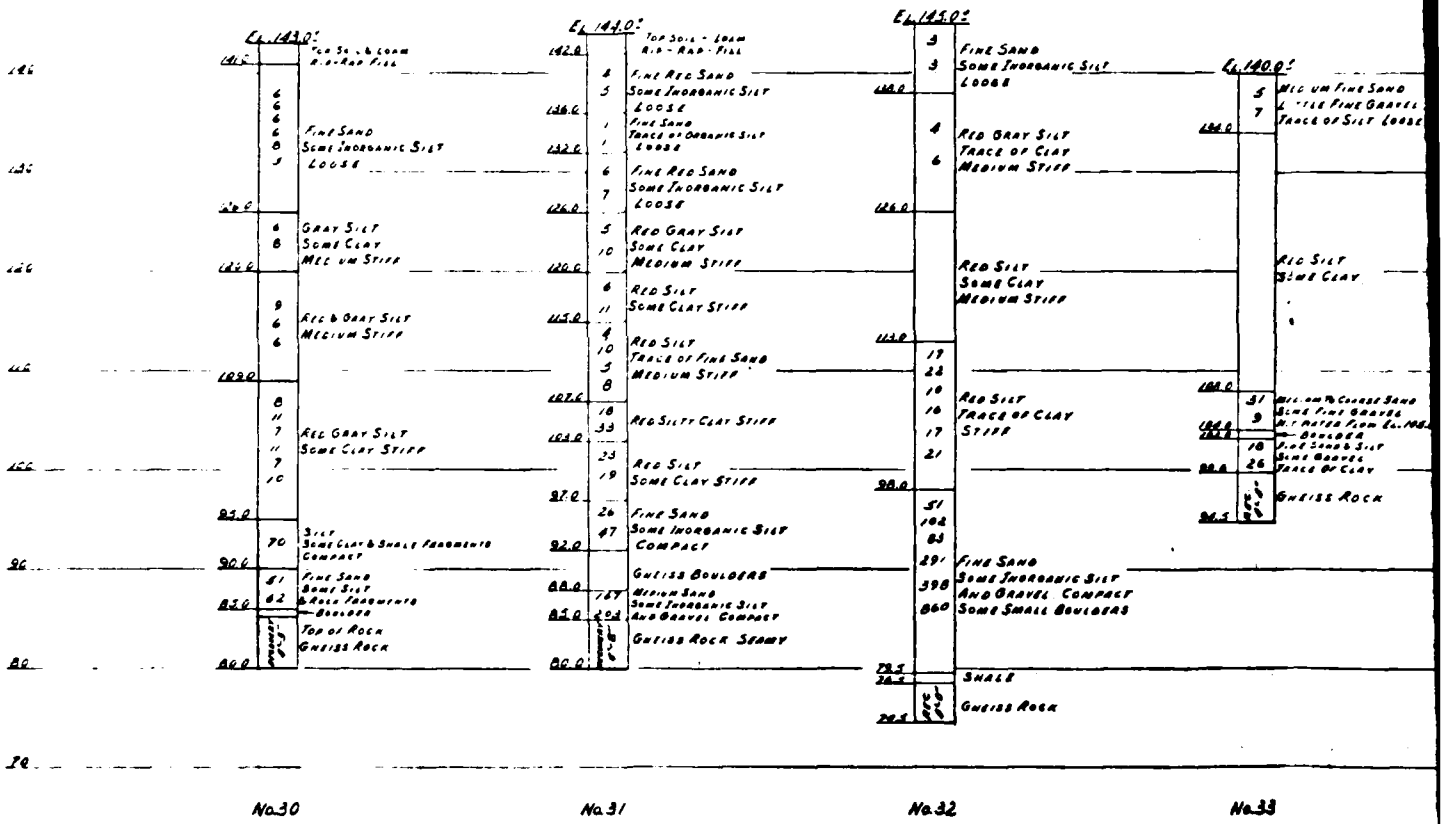
(3)

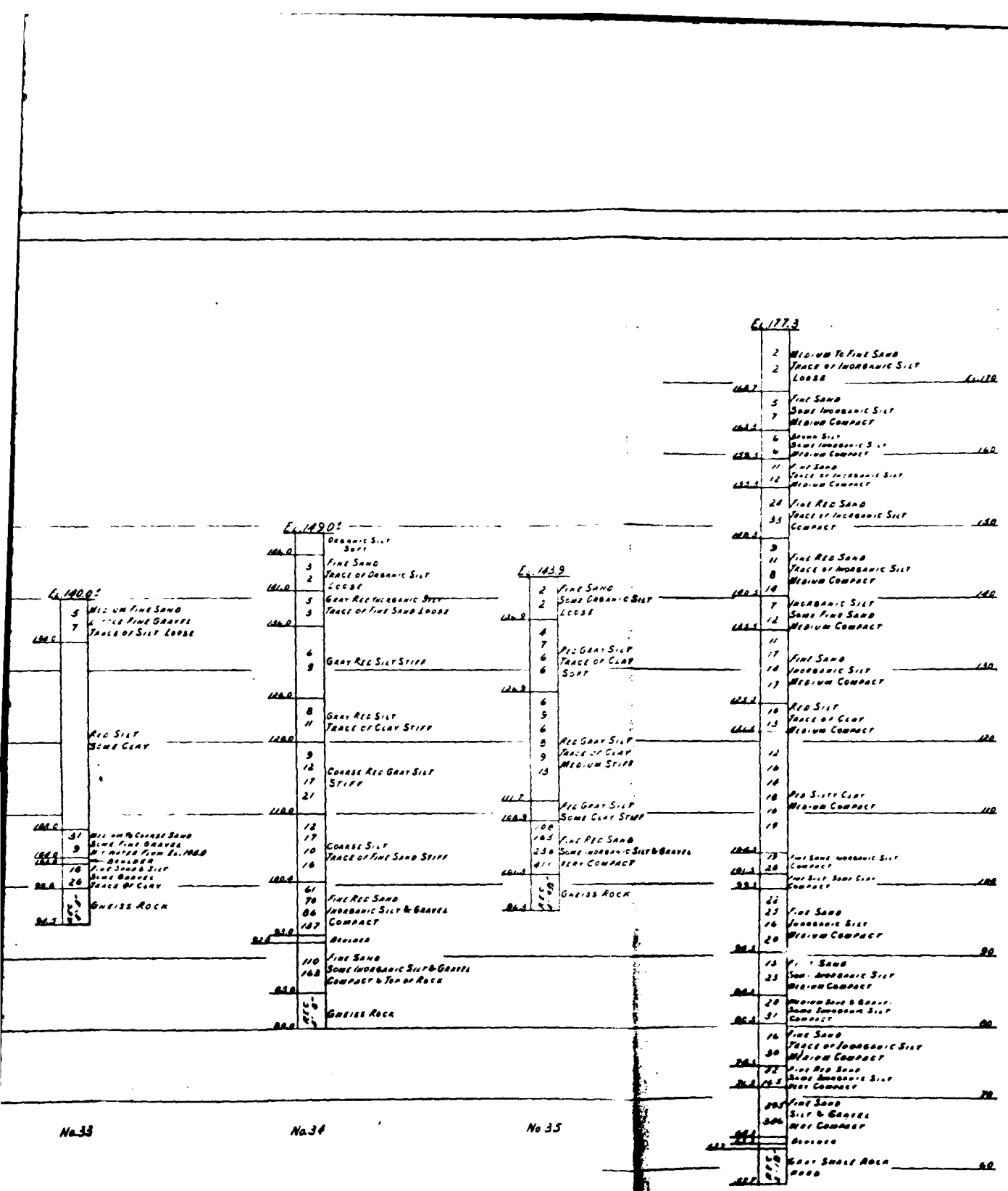
B-25



No. 10 No. 11 No. 12


El. 180
170
160
150
El. 145.5
Loose Yellow Sand Fill
Coarse Red Sand & Gravel
Red Clay Fine Sand Or Rock Flour
Hard Sand Gravel & Boulders
Loose Coarse Sand Gravel & Boulders
Hard Cemented Red Sand, Gravel, Clay, & Boulders
Drilled Rock
No. 13
Loose River Bed Fill
Rock Flour Traces Of Clay
Fine Sand & Clay
Drilled Boulder
Hard Sand Gravel & Boulders
El. 140.0
Hard Coarse Washed Sand
Loose Coarse Washed Sand & Gravel Fill
Loose Fine Sand Clay Or Rock Flour?
Firm Coarse Sand Gravel, Stone & Little Clay
Hard Coarse Sand Gravel Boulders & Little Clay
Very Compact Coarse Sand, Gravel & Boulders
Drilled Into Rock
No. 15
RECORD PLAN
BORINGS
RECONSTRUCTION OF FLOOD DAMAGE AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS.
SCALE: 1"=8'-0"
MAY, 1936
4
BT26


El. 143.0'
Top Soil - Loam
R.R.-Rad. Fill
Fine Sand
Some Inorganic Silt
Loose
Gray Silt
Some Clay
Medium Stiff
Red & Gray Silt
Medium Stiff
Red Gray Silt
Some Clay Stiff
Silt
Some Clay & Shale Fragments
Compact
Fine Sand
Some Silt
& Rock Fragments
Boulders
Top of Rock
Gneiss Rock
No.30
El. 144.0'
Top Soil - Loam
R.R. - Rad. Fill
Fine Red Sand
Some Inorganic Silt
Loose
Fine Sand
Trace of Organic Silt
Loose
Fine Red Sand
Some Inorganic Silt
Loose
Red Gray Silt
Some Clay
Medium Stiff
Red Silt
Some Clay Stiff
Red Silt
Trace of Fine Sand
Medium Stiff
Red Silty Clay Stiff
Red Silt
Some Clay Stiff
Fine Sand
Some Inorganic Silt
Compact
Gneiss Boulders
Medium Sand
Some Inorganic Silt
And Gravel Compact
Gneiss Rock Seamy
No.31
El. 145.0'
Fine Sand
Some Inorganic Silt
Loose
Red Gray Silt
Trace of Clay
Medium Stiff
Red Silt
Some Clay
Medium Stiff
Red Silt
Trace of Clay
Stiff
Fine Sand
Some Inorganic Silt
And Gravel Compact
Some Small Boulders
Shale
Gneiss Rock
No.32
El. 140.0'
Red Silt
Some Clay
No.33



RECORD PLAN

BORINGS

RECONSTRUCTION OF FLOOD DAMAGE
AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS.

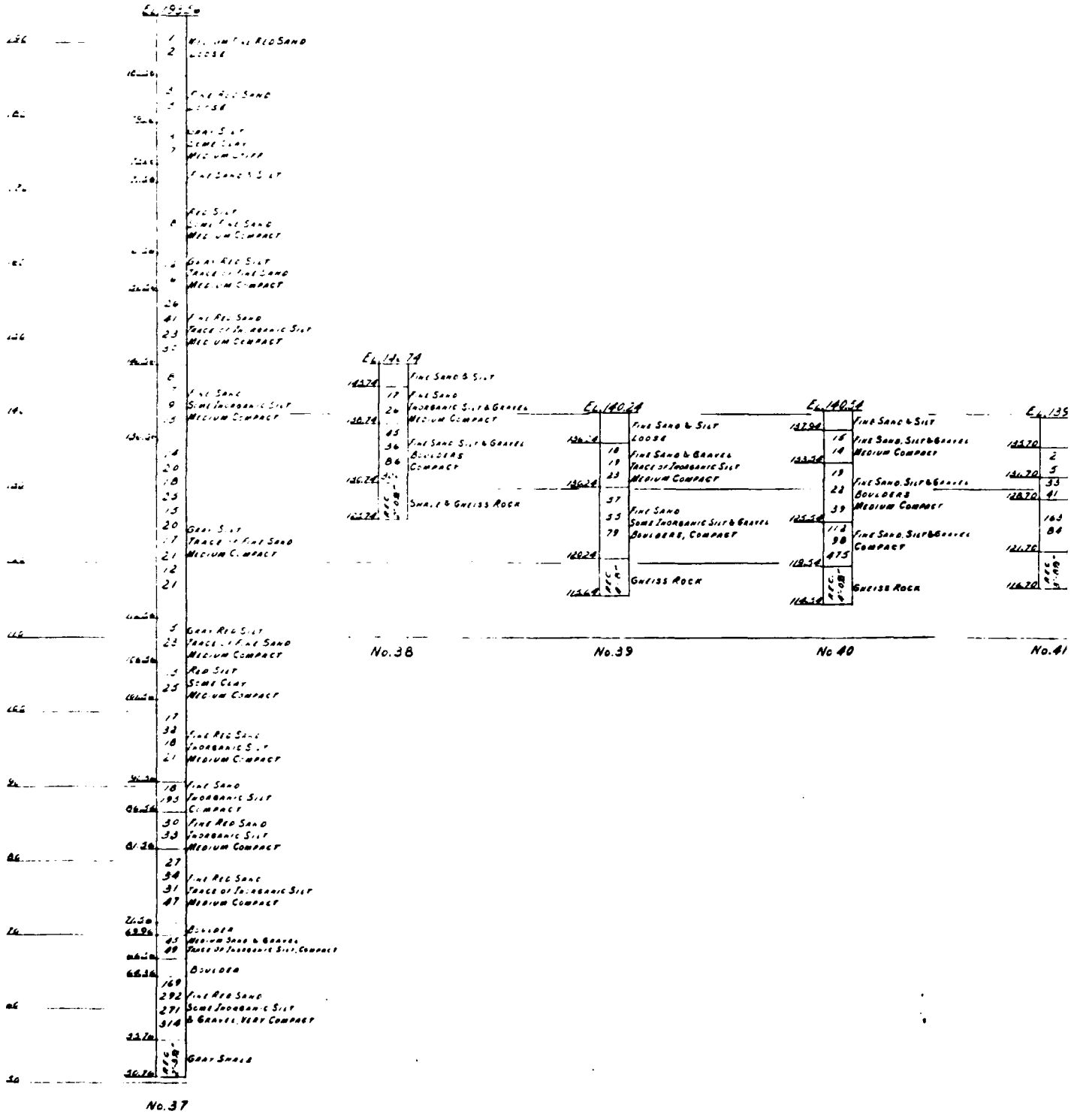
THORP & BROWN, CONSULTING ENGINEERS.
SPRINGFIELD, MASS.

SCALE: 1"=8'-0" MAY, 1956

(5)

B-27

2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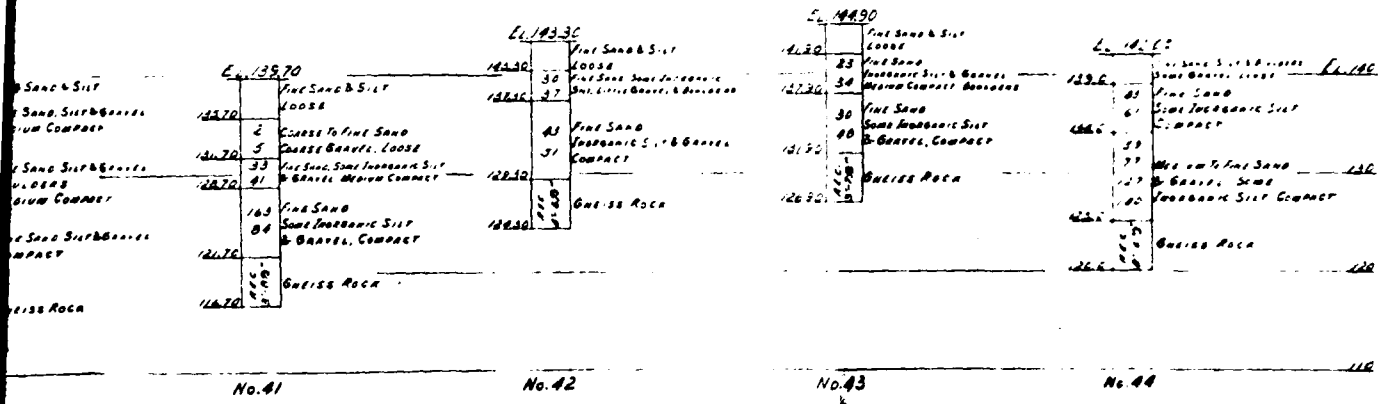
No. 38
No. 39
No. 40
No. 41



RECORD PLAN

BORINGS

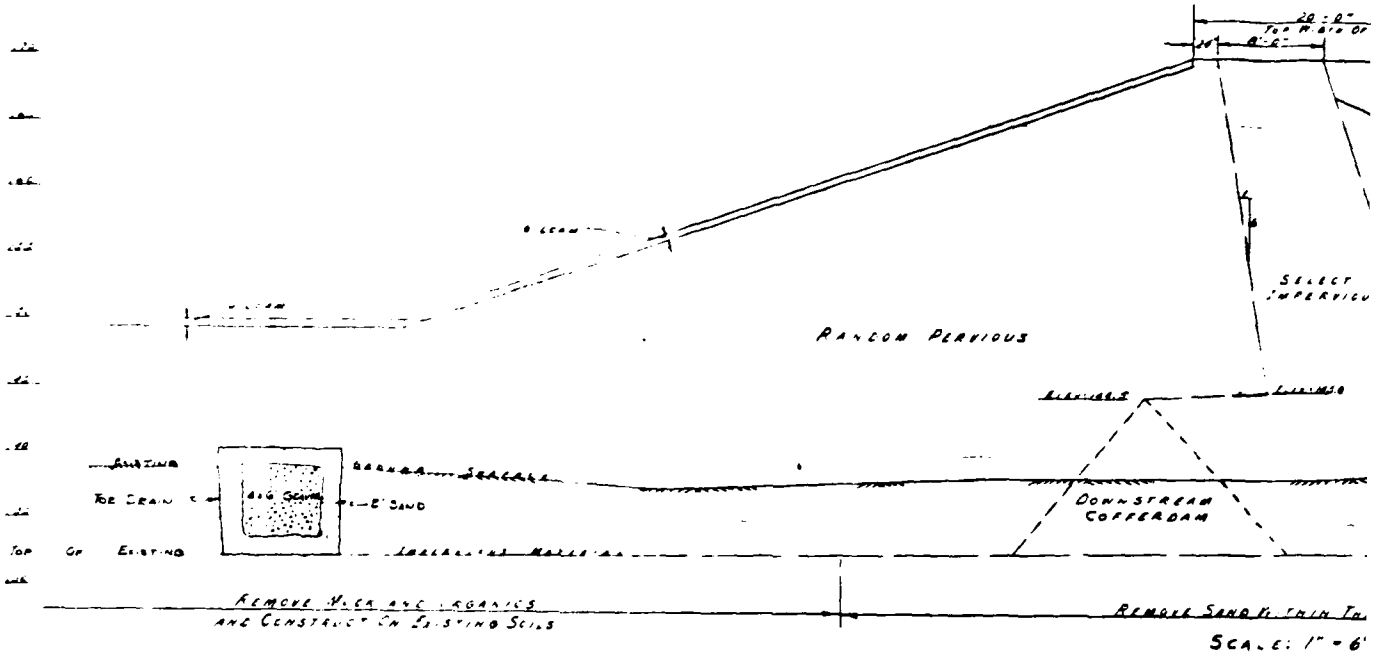
RECONSTRUCTION OF FLOOD DAMAGE
AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS.

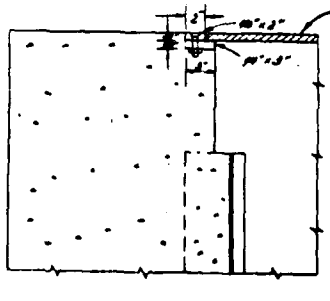
THOMPSON & BROWN, CONSULTING ENGINEERS
BOSTON, MASS.

SCALE: 1"=8'-0" MAY 1956

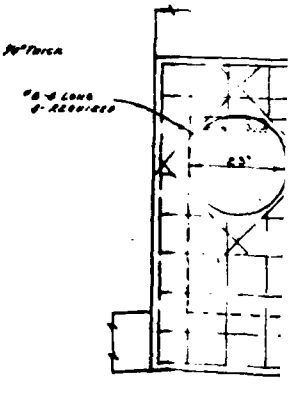
6

B-28

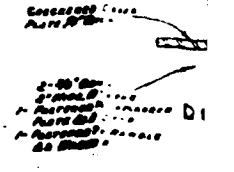


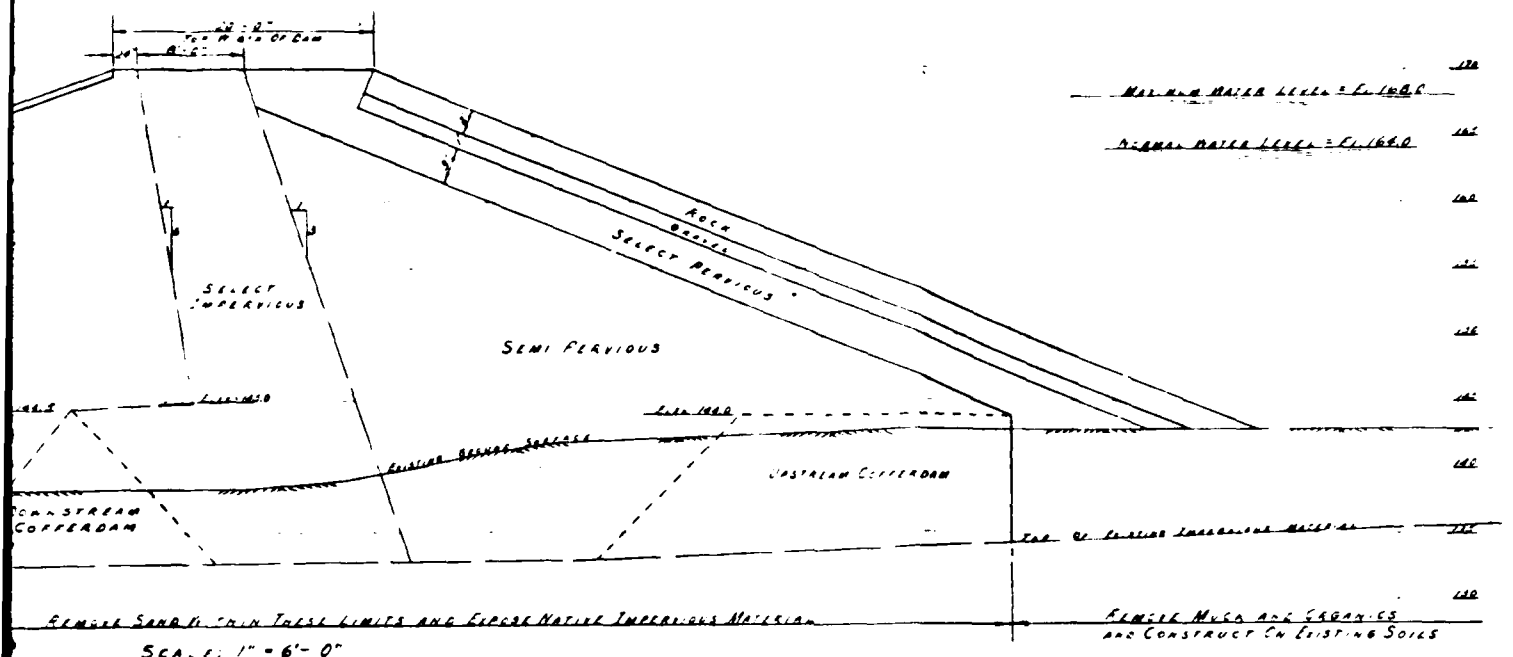


SECTION A-A
NOT TO SCALE

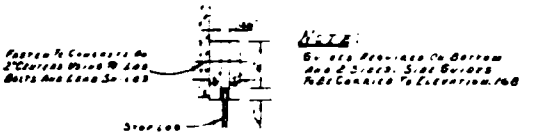


PLAN O

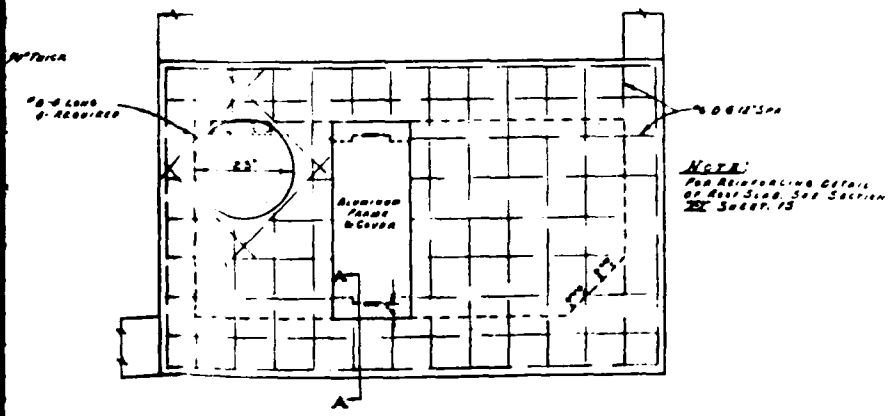




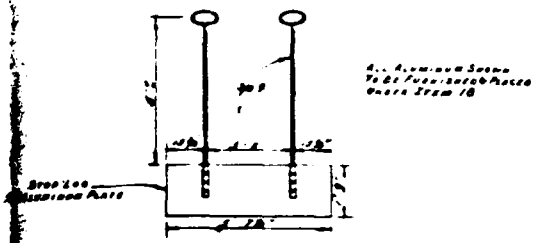
SCALE: 1" = 6'-0"



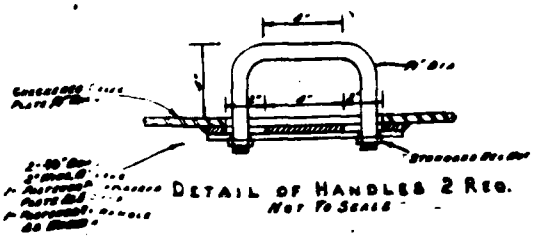
GUIDE DETAIL
NOT TO SCALE



PLAN OF ROOF SLAB AT SCREEN WELL
SCALE 1/4"=1'-0"



STOP LOG DETAIL
NOT TO SCALE



DETAIL OF HANDLES 2 REQ.
NOT TO SCALE

RECORD PLAN

DETAILS OF DAM

RECONSTRUCTION OF FLOOD DAMAGE AT

BEAR HOLE DAM

BOARD OF WATER COMMISSIONERS

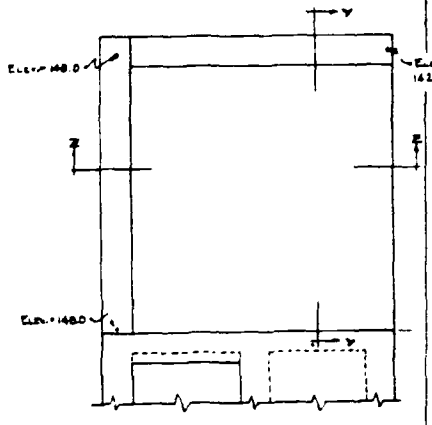
TOWN OF WEST SPRINGFIELD MASS.

THOMAS O. DAMON CONSULTING ENGINEERS
SPRINGFIELD MASS.

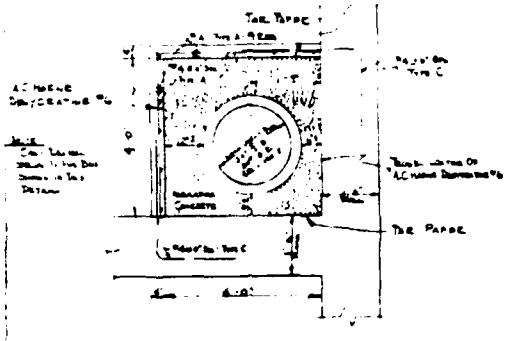
SCALE: AS SHOWN MAY 1956

(7)

PLAN OF SCREEN WELL

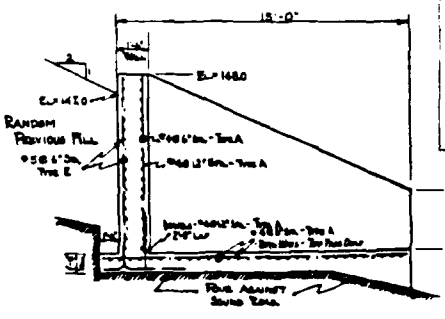


PLAN OF INTAKE APRON

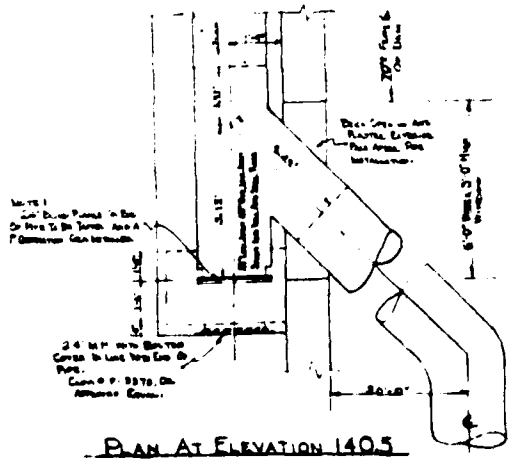


TYPICAL ARRANGEMENT
24 PIPE INSTALLATION AND INSULATION

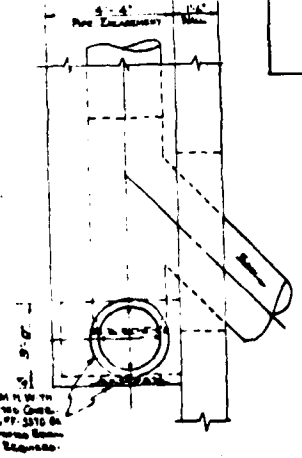
CONSTRUCTION PROCEDURE



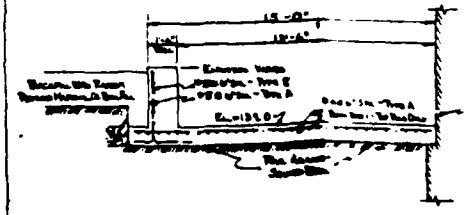
SECTION Z-Z



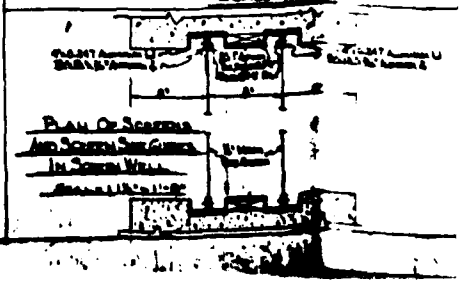
PLAN AT ELEVATION 140.5



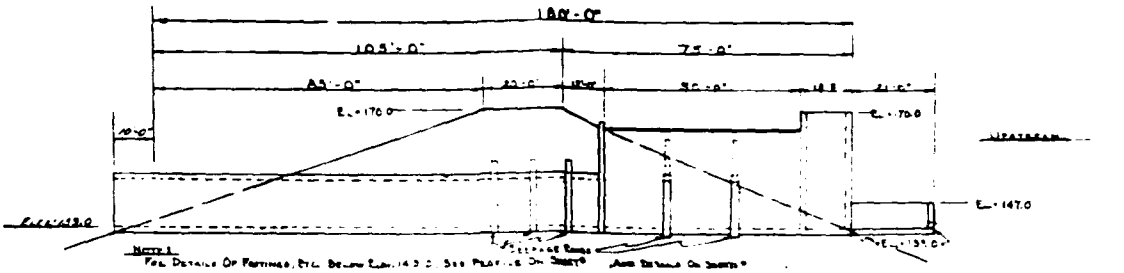
ROOF PLAN AT ELEVATION 143.33



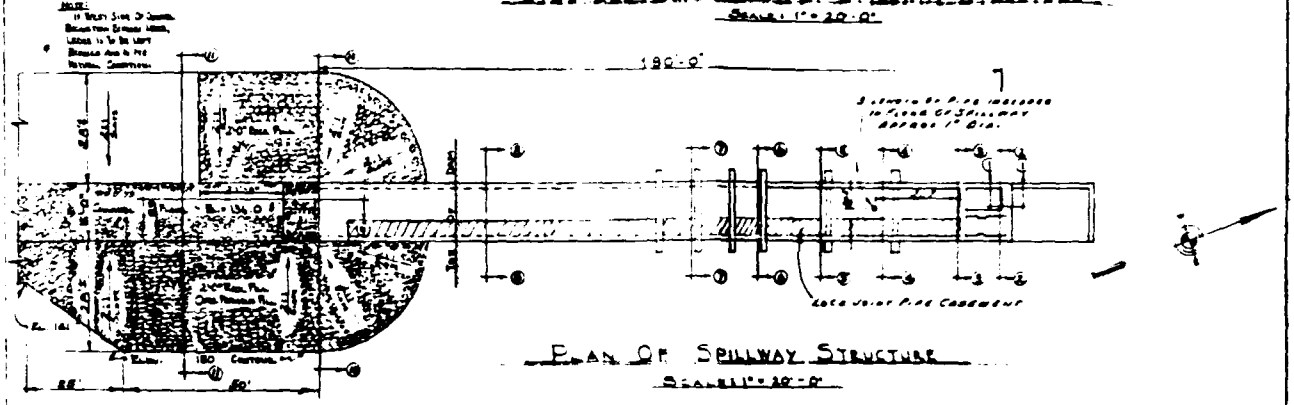
SECTION Y-Y



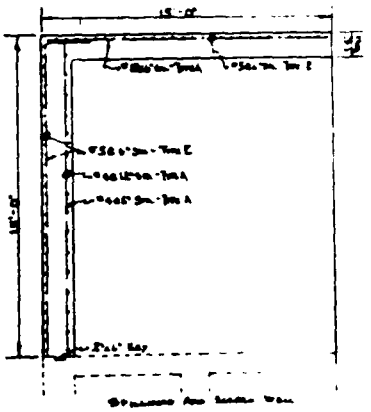
PLAN OF SCREENS AND SCREEN SIDE GUIDES IN SCREEN WELL



SIDE ELEVATION (EAST) OF SPILLWAY STRUCTURE

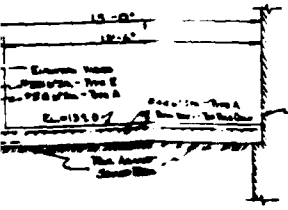


PLAN OF SPILLWAY STRUCTURE

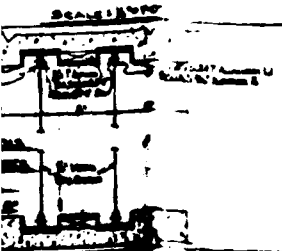


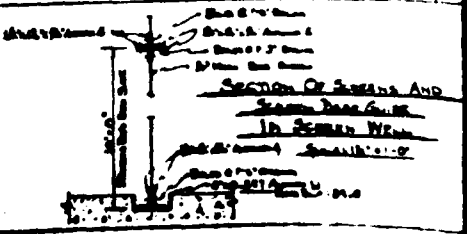
PLAN OF INTAKE APRON AT ELEVATION 162.0

BENDING SCHEDULE	
A	
B	
C	
D	
E	
F	
G	



SECTION Y-Y





SECTION OF SPILLWAY AND STILLING BASIN AT SCREEN WELL

SPILLWAY DETAILS

RECONSTRUCTION OF FLOOD DAMAGE AT

BEAR HOLE DAM

BOARD OF WATER COMMISSIONERS

TOWN OF WEST SPRINGFIELD, MASS.

SCALE: AS SHOWN MAY 1956

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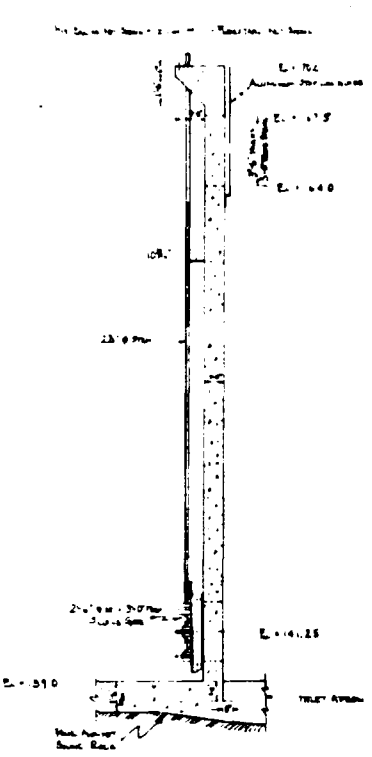
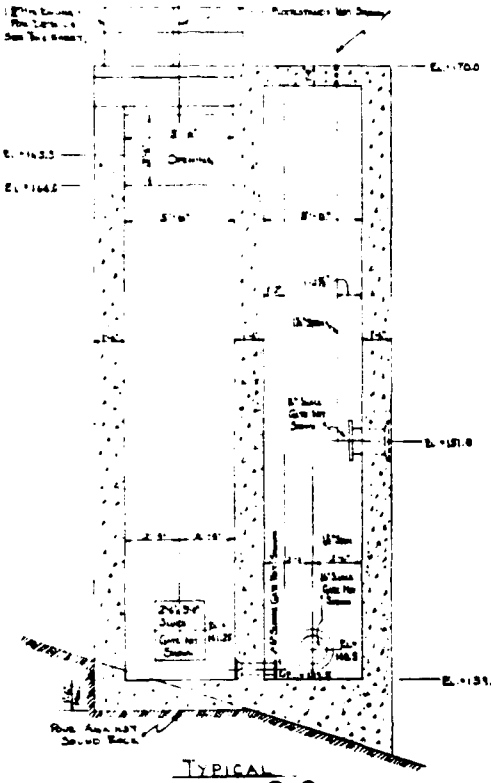
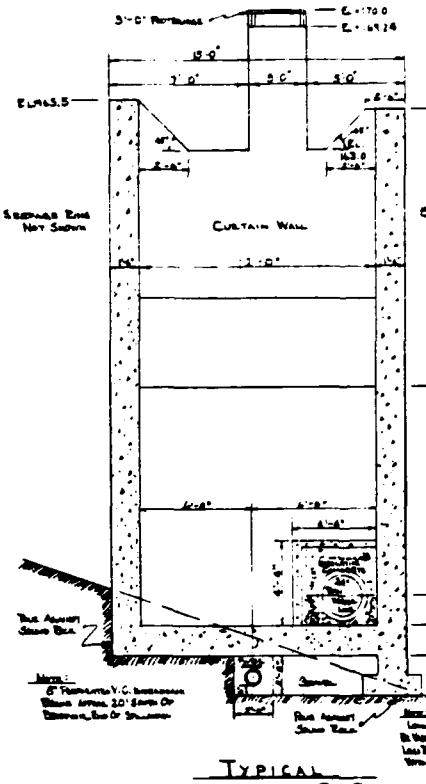


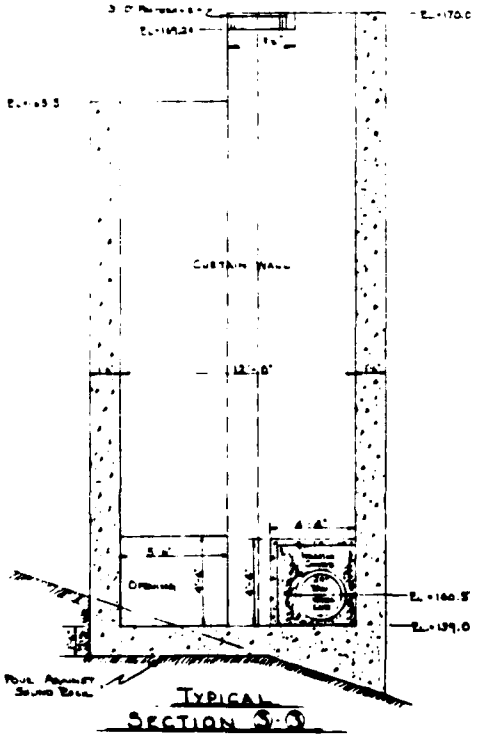
SECTION 1-1



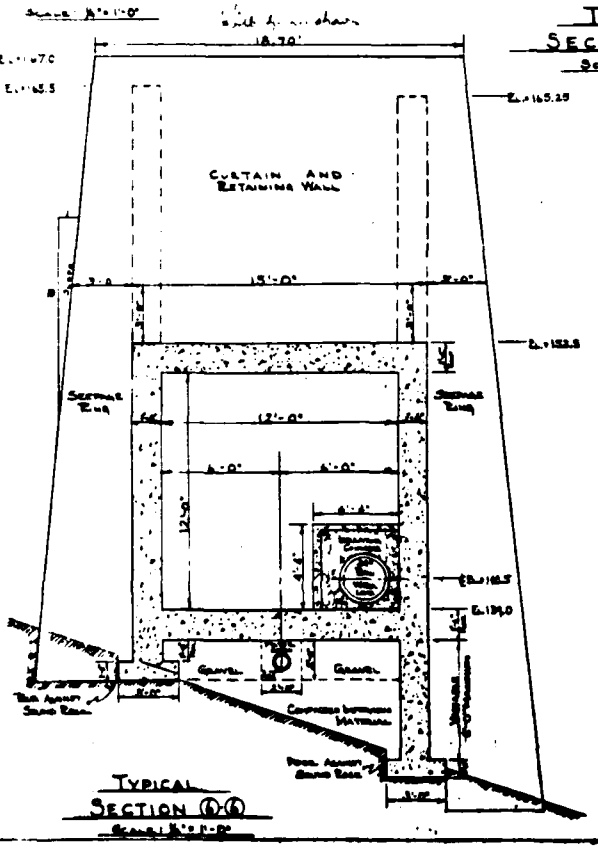
TYPICAL SECTION 2-2



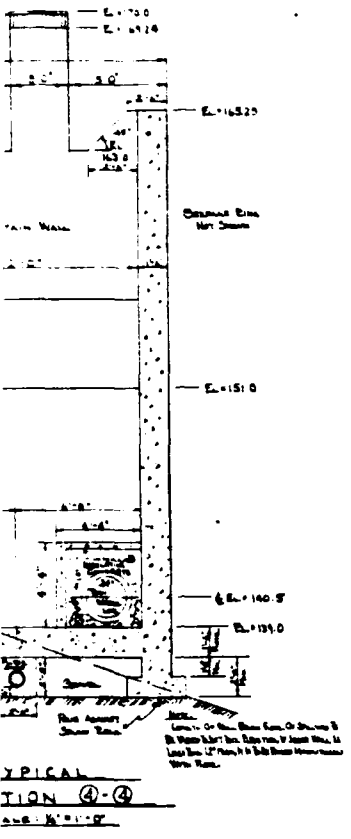
TYPICAL SECTION 4-4



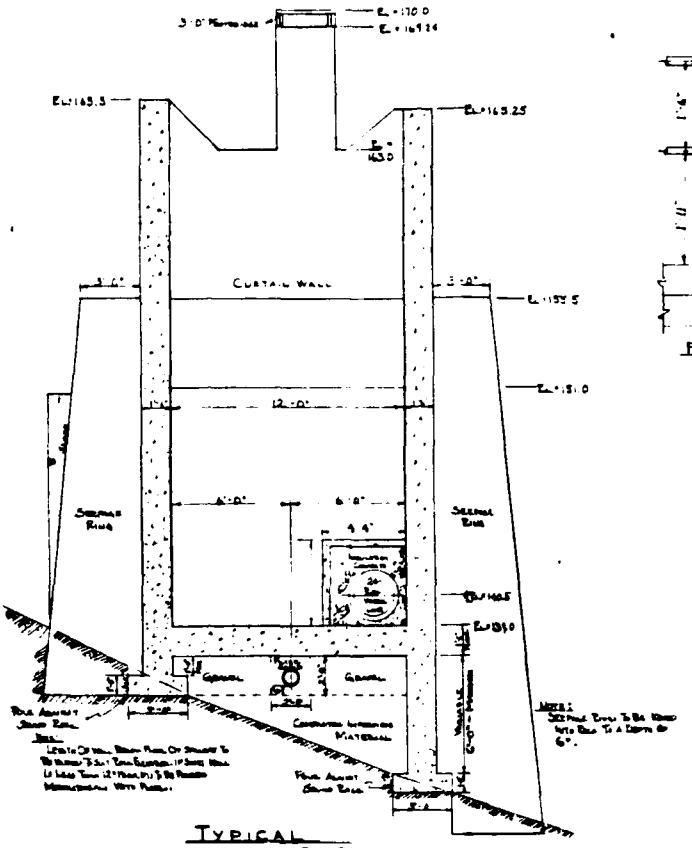
TYPICAL SECTION 5-5



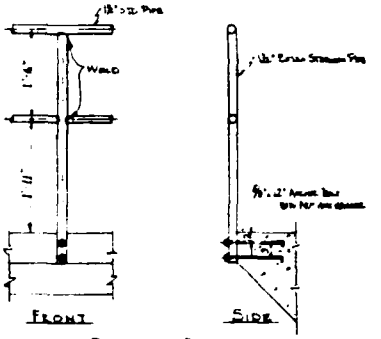
TYPICAL SECTION 6-6



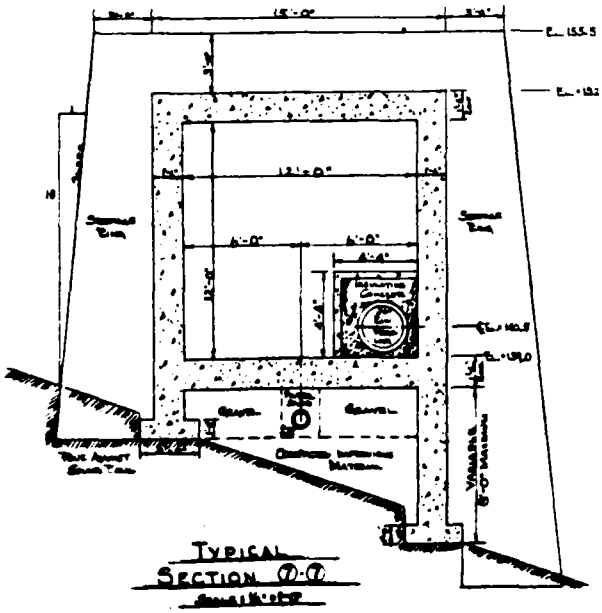
TYPICAL
TION ④-④



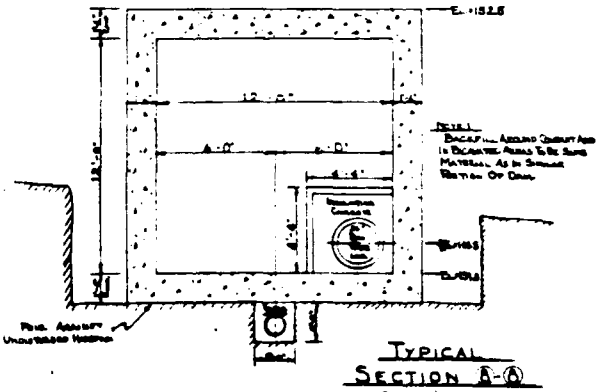
TYPICAL
SECTION ⑤-⑤



DETAIL OF
PIPE RAILING



TYPICAL
SECTION ⑦-⑦



TYPICAL
SECTION ⑧-⑧

SPILLWAY SECTIONS

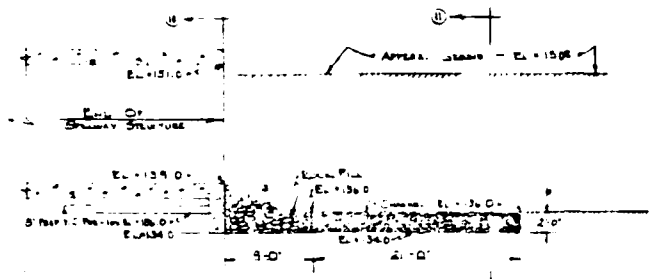
RECONSTRUCTION OF FLOOD DAMAGE
AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS.

TIBBE & BOND CONSULTING ENGINEERS
HOLYOKE, MASS.

SCALE: AS SHOWN. MAY, 1956

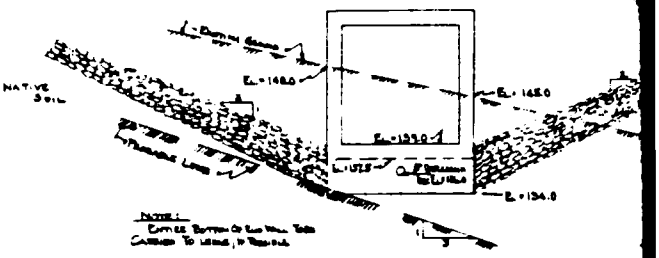
12

2



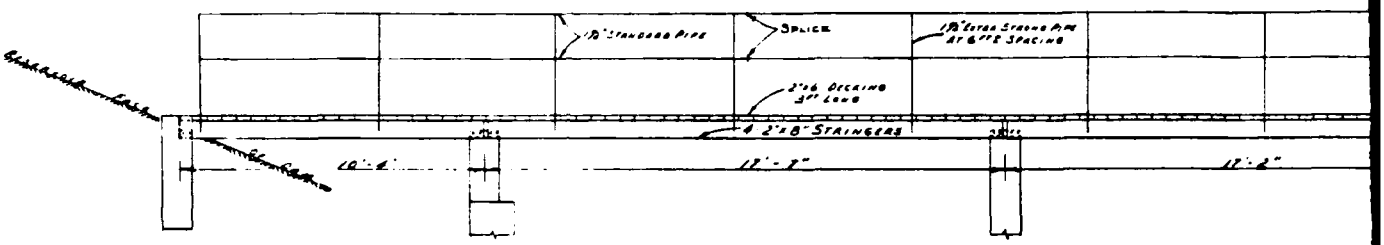
SECTION 9-9

SCALE: 1/4" = 1'-0"



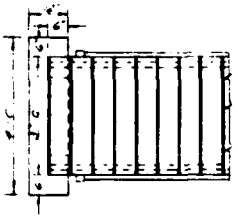
SECTION 10-10

SCALE: 1/4" = 1'-0"

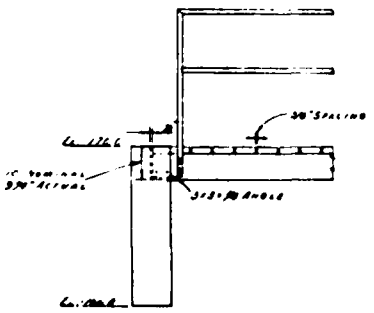


EAST ELEVATION OF BRIDGE

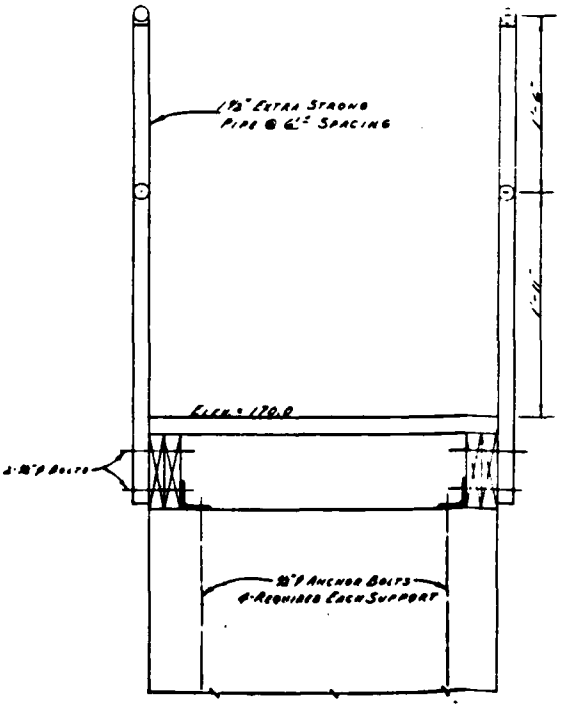
SCALE: 1/8" = 1'-0"



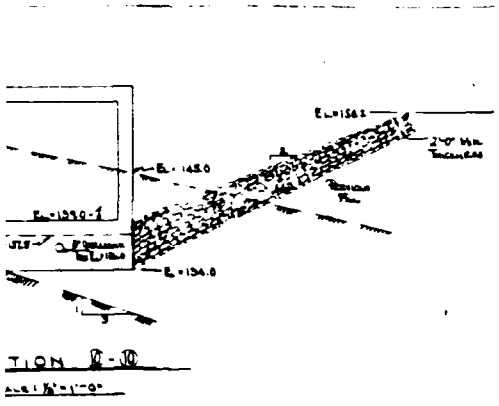
PLAN



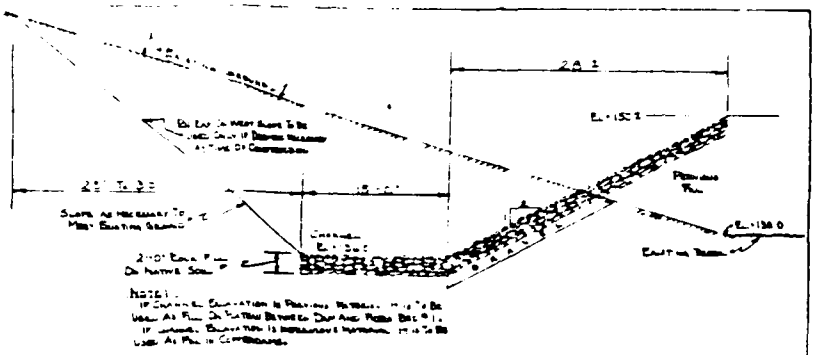
TYPICAL DETAIL
END OF BRIDGE AT DAM
SCALE: 1/2" = 1'-0"



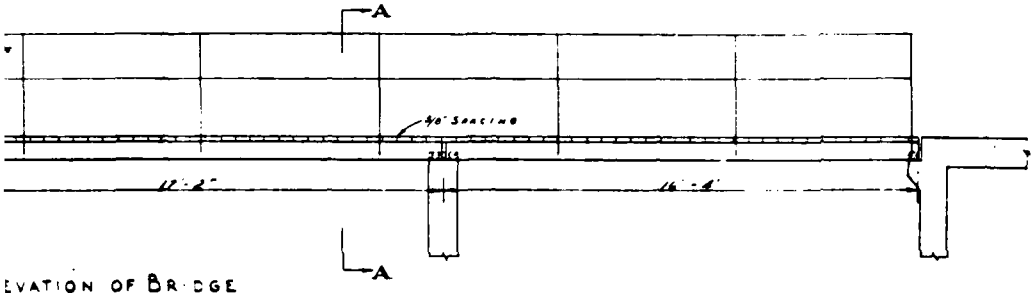
SECTION A-A
SCALE: 1/2" = 1'-0"



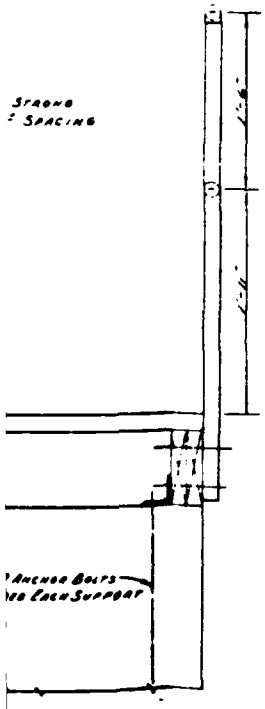
TION B-B



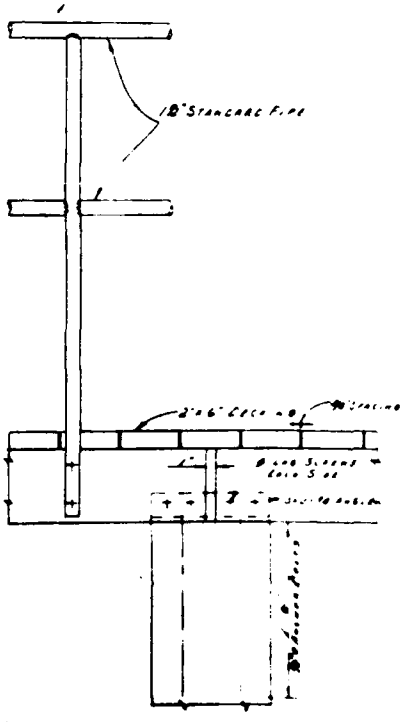
SECTION A-A



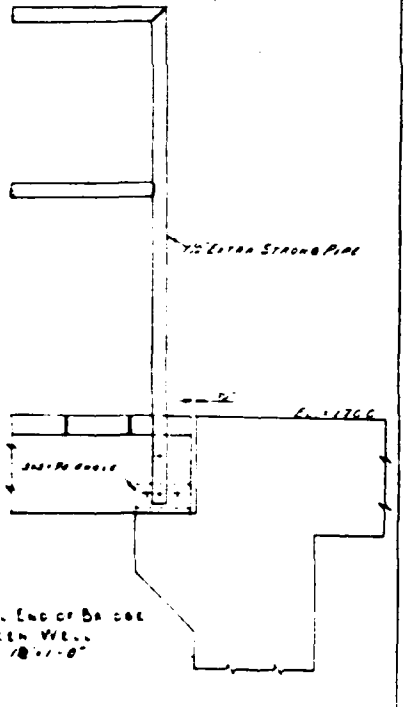
EVATION OF BRIDGE
SCALE 1/8"=1'-0"



ION A-A



TYPICAL DETAIL AT SUPPORT
SCALE: 1/8"=1'-0"



TYPICAL DETAIL END OF BRIDGE
AT SCREEN WELL
SCALE 1/8"=1'-0"

CHANNEL SECTIONS
AND
SPILLWAY BRIDGE DETAILS
RECONSTRUCTION OF FLOOD DAMAGE
AT
BEAR HOLE DAM
BOARD OF WATER COMMISSIONERS
TOWN OF WEST SPRINGFIELD, MASS
TIGHE & BOND CONSULTING ENGINEERS
HOLYOKE MASS
SCALE: AS SHOWN MAY 1936

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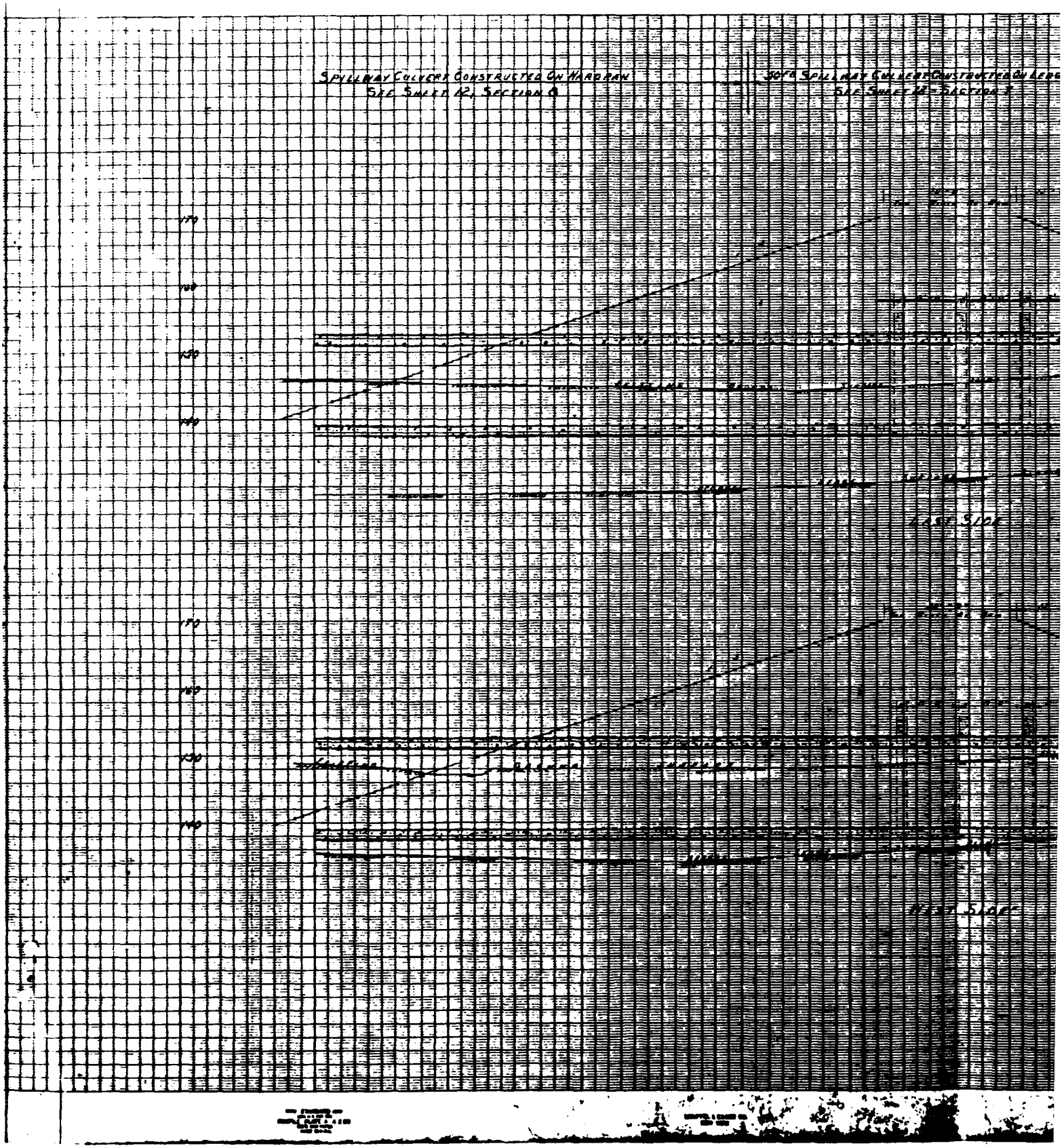
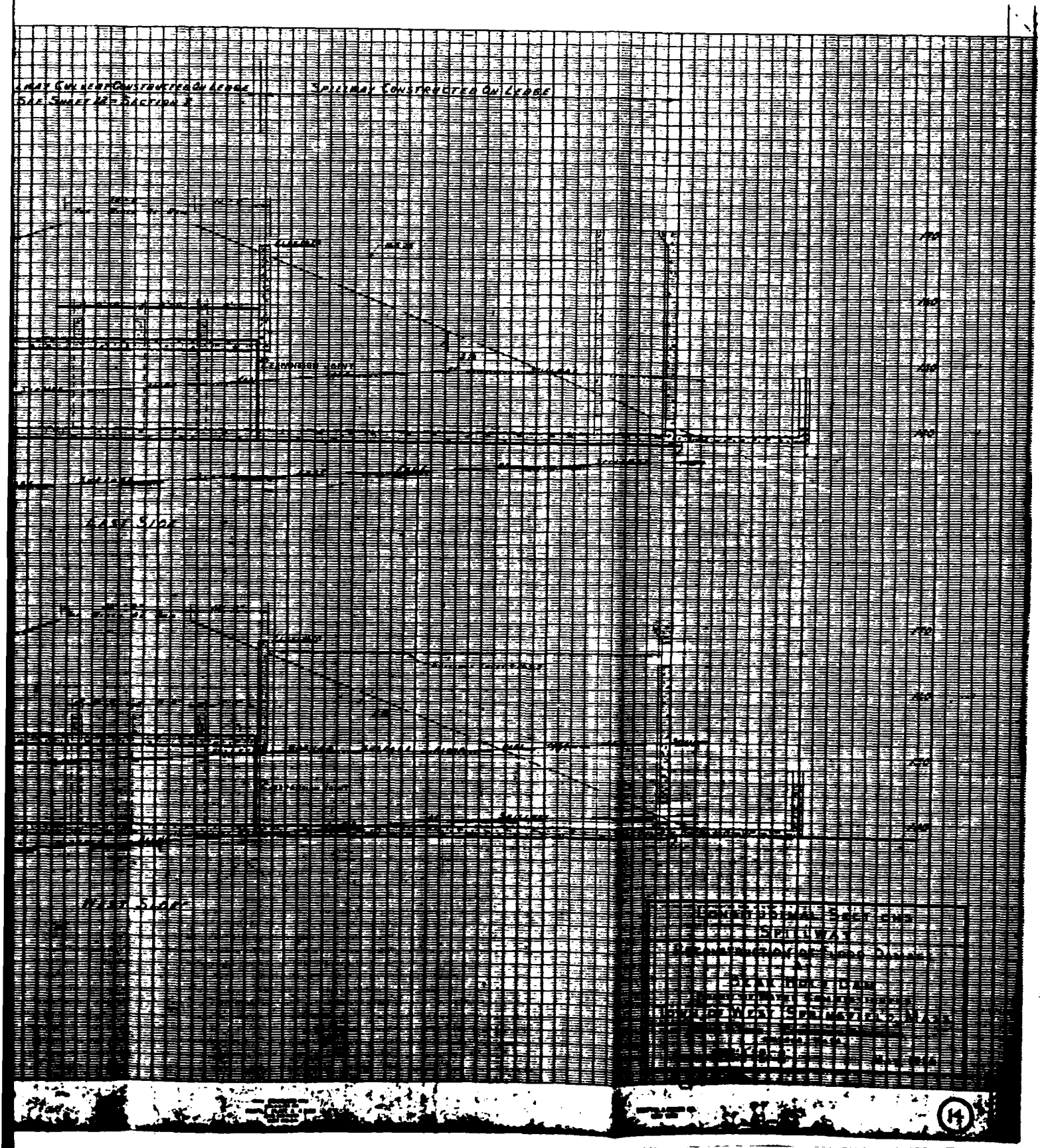
2

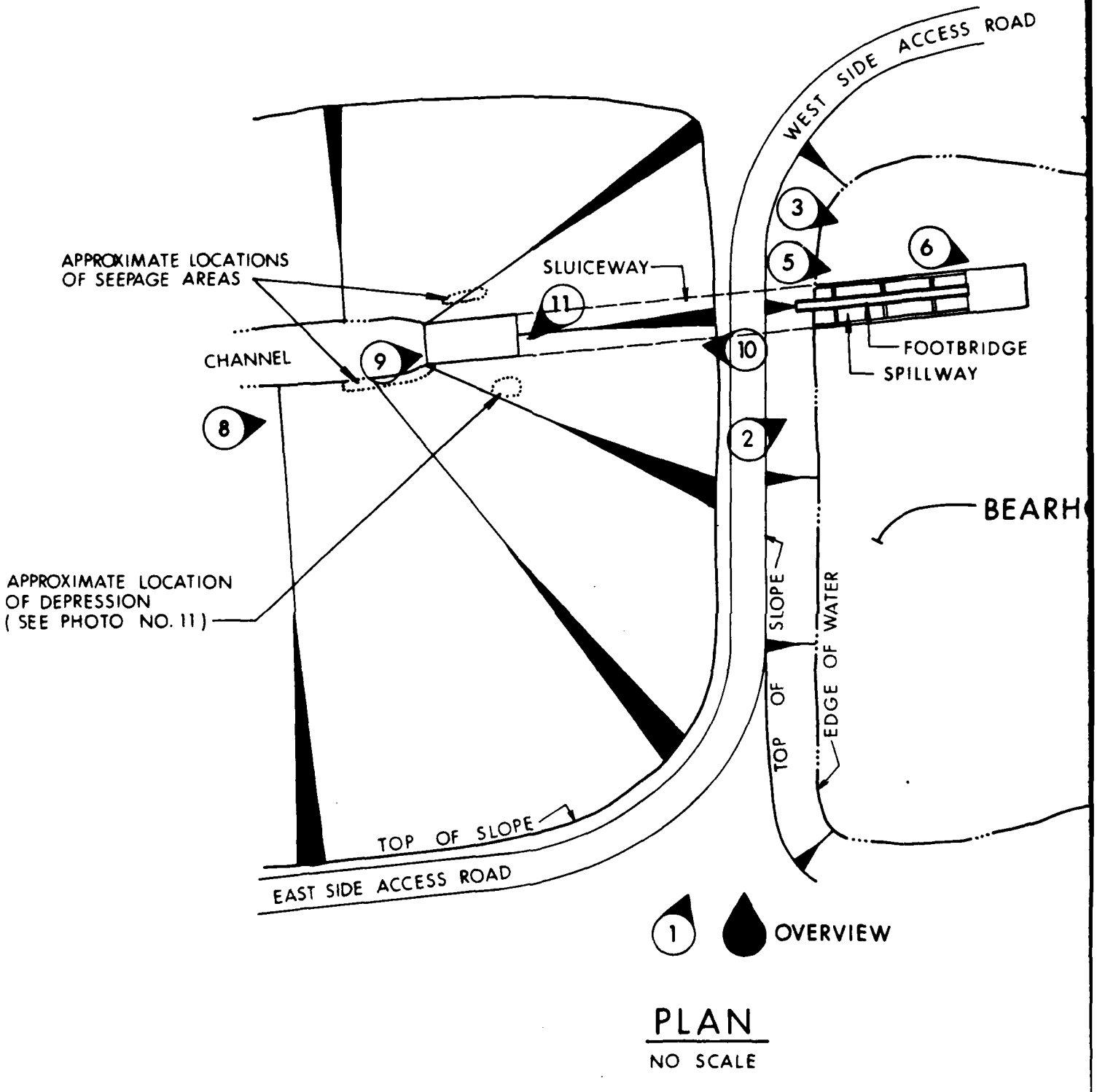

SPILLWAY COLVERT CONSTRUCTED ON HARD PAN
SEE SHEET 12, SECTION A
30'd SPILLWAY CULVERT CONSTRUCTED ON LEDGE
SEE SHEET 14 - SECTION 2
170
160
150
140



2

APPENDIX C

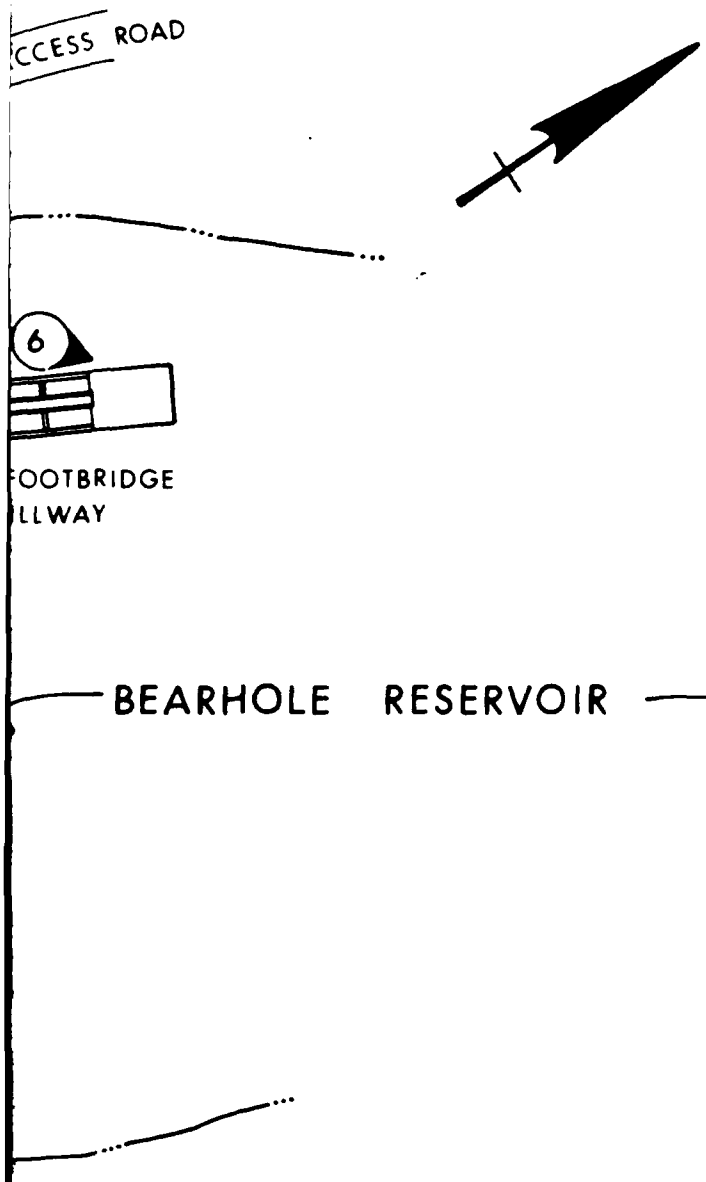
PHOTOGRAPHS



PLAN

NO SCALE

FIGURE 2



DENOTES PHOTO NUMBER AND DIRECTION IN WHICH PHOTO WAS TAKEN

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO LOCATION PLAN
BEARHOLE RESERVOIR
WEST SPRINGFIELD, MASS.

SCALE NO SCALE		DATE MARCH 1981	
DWN NP	CKD GV	APP KH	PAGE C-1

CULLINAN ENGINEERING CO., INC.
CIVIL ENGINEERS
AUBURN – BOSTON, MASSACHUSETTS

PHOTO NO. 1
VIEW OF DAM FROM LEFT ABUTMENT

PHOTO NO. 2
VIEW OF SPILLWAY FROM LEFT SIDE

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam Paucatuc Brook West Springfield, MA MA 00073 March 4, 1981
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		

PHOTO NO. 3
VIEW OF SPILLWAY FROM RIGHT SIDE

PHOTO NO. 4
VIEW OF SPILLWAY FROM UPSTREAM

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam
		Paucatuc Brook
		West Springfield, MA
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		MA 00073
		March 4, 1981

PHOTO NO. 5
VIEW OF END WEIR ON SPILLWAY
AND OPERATOR FOR GATE ON
RESERVOIR DRAIN

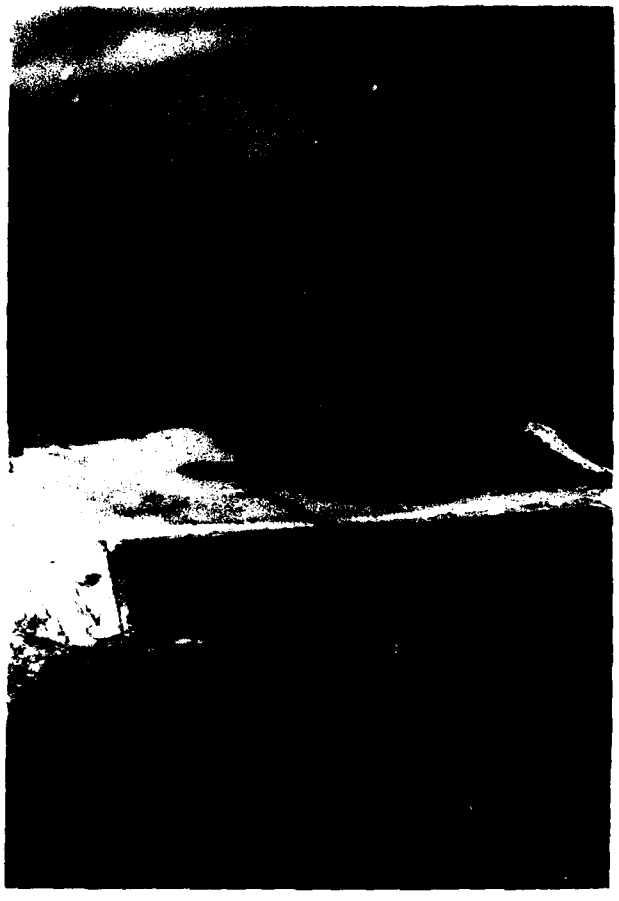


PHOTO NO. 6
VIEW OF ACCESS HATCHES FOR
RAW WATER INTAKE WELL AND
OPERATORS FOR RAW WATER
INTAKE GATES

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam
		Paucatuc Brook
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		West Springfield, MA
		MA 00073
		March 4, 1981

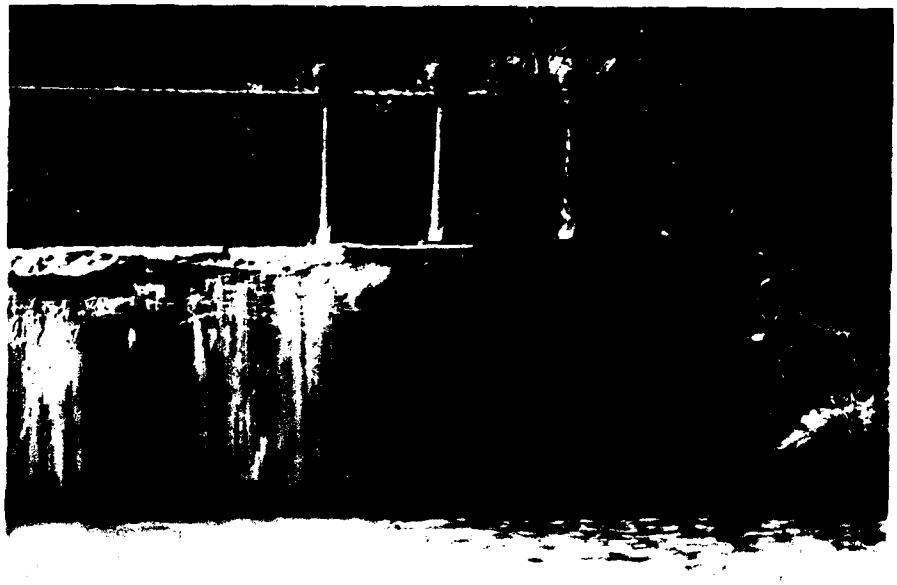


PHOTO NO. 7
UPSTREAM VIEW OF SPILLWAY SHOWING SHORT WEIR AND GATE OPERATORS. NOTE DETERIORATION OF CONCRETE.

PHOTO NO. 8
VIEW OF SLUICEWAY OUTLET LOOKING UPSTREAM. NOTE CONCRETE ENCASEMENT FOR RAW WATER SUPPLY LINE IN LOWER RIGHT CORNER OF SLUICEWAY.

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam Paucatuc Brook West Springfield, MA MA 00073 March 4, 1981
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		

PHOTO NO. 9
VIEW OF SEEPAGE AT LEFT
SIDE OF SLUICEWAY

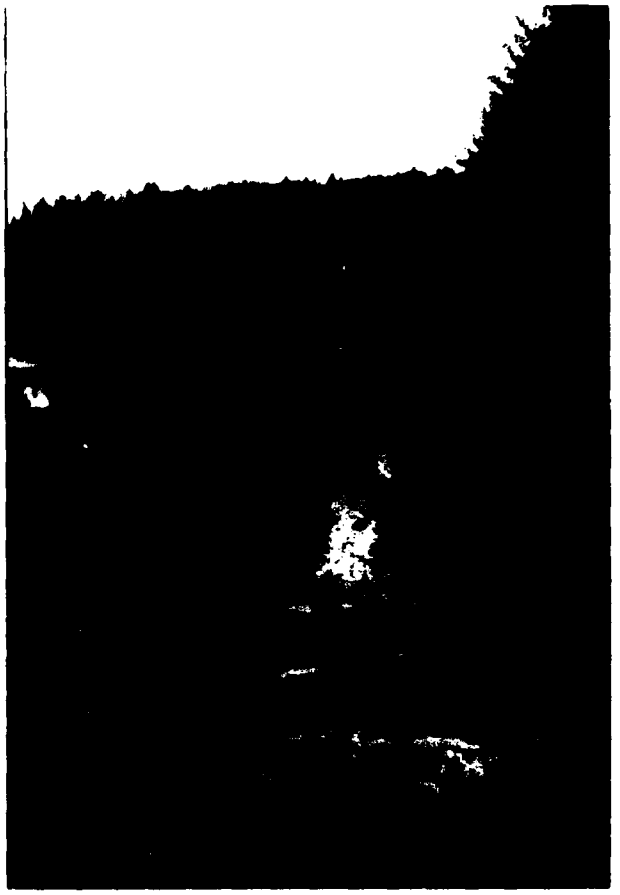


PHOTO NO. 10
VIEW OF SLUICEWAY OUTLET
AND DOWNSTREAM CHANNEL.
NOTE PROXIMITY OF FILTRATION
PLANT/PUMPING STATION TO
LEFT SIDE OF CHANNEL.

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam Paucatuc Brook West Springfield, MA MA 00073 March 4, 1981
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		

PHOTO NO. 11
VIEW OF DEPRESSION IN RIP-RAP SLOPE AT
LEFT SIDE OF OUTLET CHANNEL

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION WALTHAM, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bearhole Reservoir Dam Paucatuc Brook West Springfield, MA MA 00073 March 4, 1981
CULLINAN ENGINEERING CO., INC. CIVIL ENGINEERS AUBURN-BOSTON, MASSACHUSETTS		

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

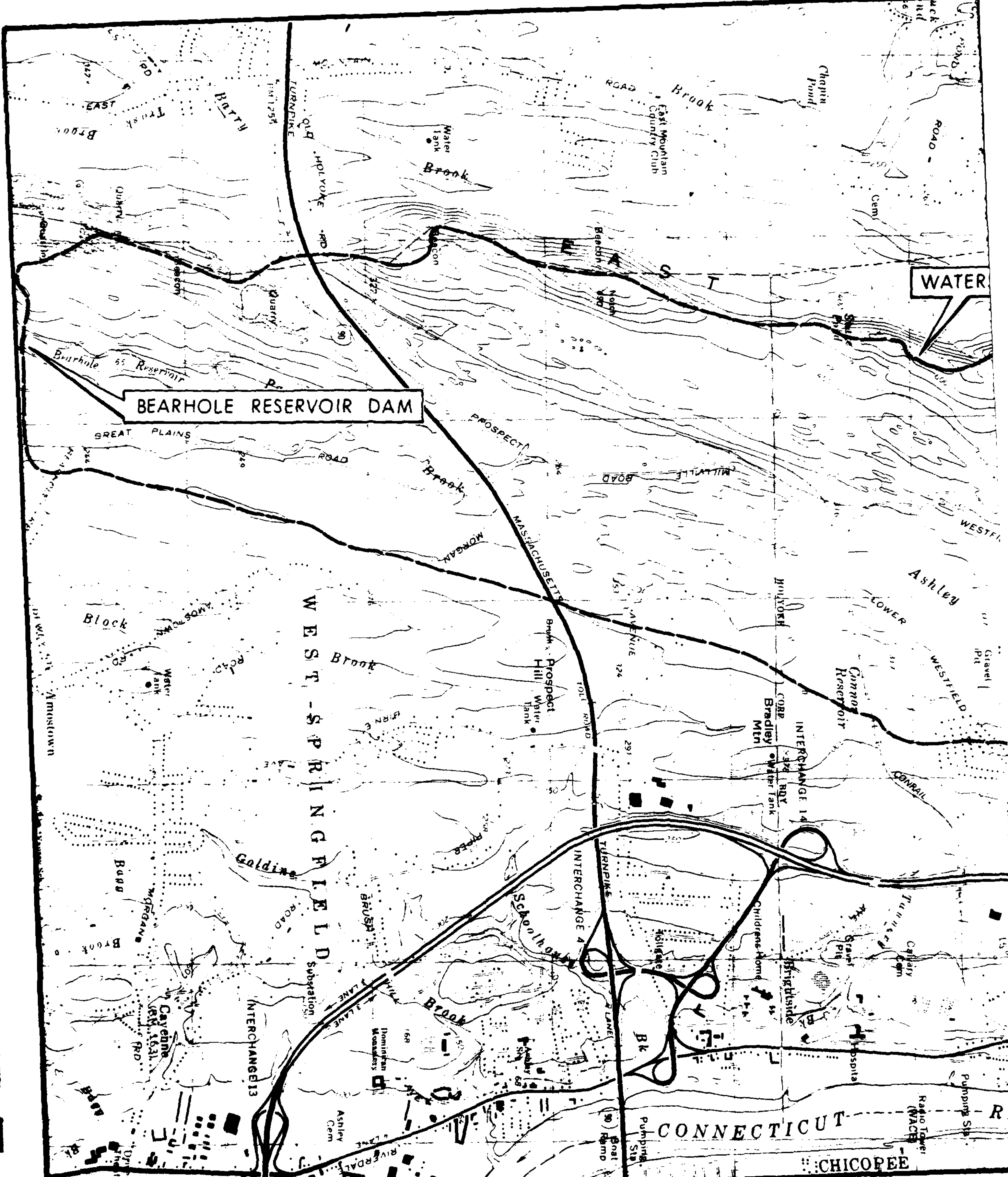
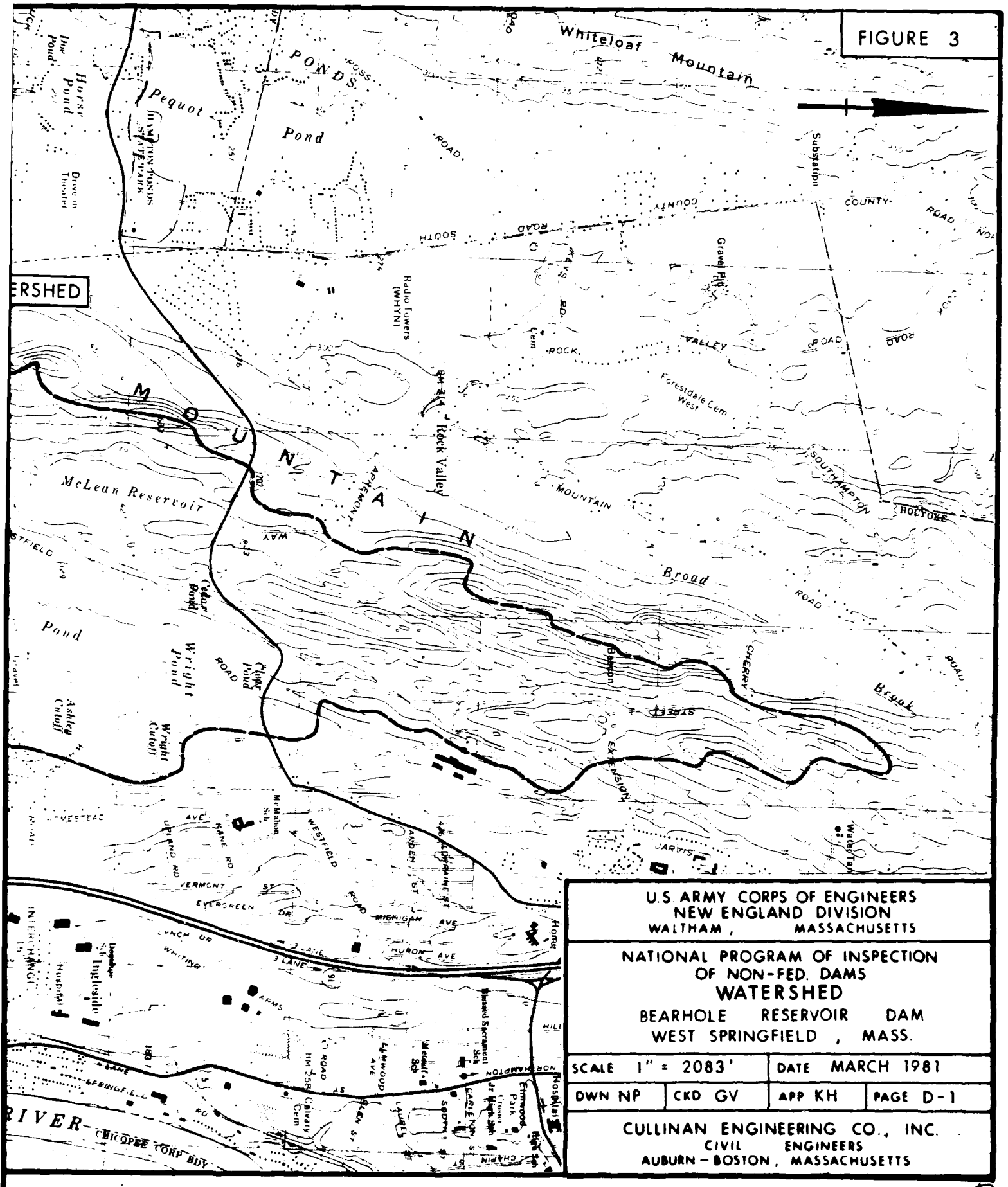

BEARHOLE RESERVOIR DAM
WATER
WEST SPRINGFIELD
CONNECTICUT
CHICOPEE
Bearhole Reservoir
Prospect Hill
Bradley Mtn
Connor Reservoir
INTERCHANGE 4
INTERCHANGE 13
INTERCHANGE 14
MASSACHUSETTS TURNPIKE
East Mountain Country Club
Chapin Pond
Amostown
Cayenne
Ashley Cem
Dominican Monastery
Childrens Home
Brightside
Hospital
Pumping Sta
Radio Tower (WACE)
Boat Ramp
Schoolhouse
Goldine
Block
Brook
Ashley
CONRAIL
RIVERDALE
PROSPECT
MORGAN
GREAT PLAINS
ROAD
Water Tank
Quarry
Substation
Gravel Pit
Calvary Cem

FIGURE 3



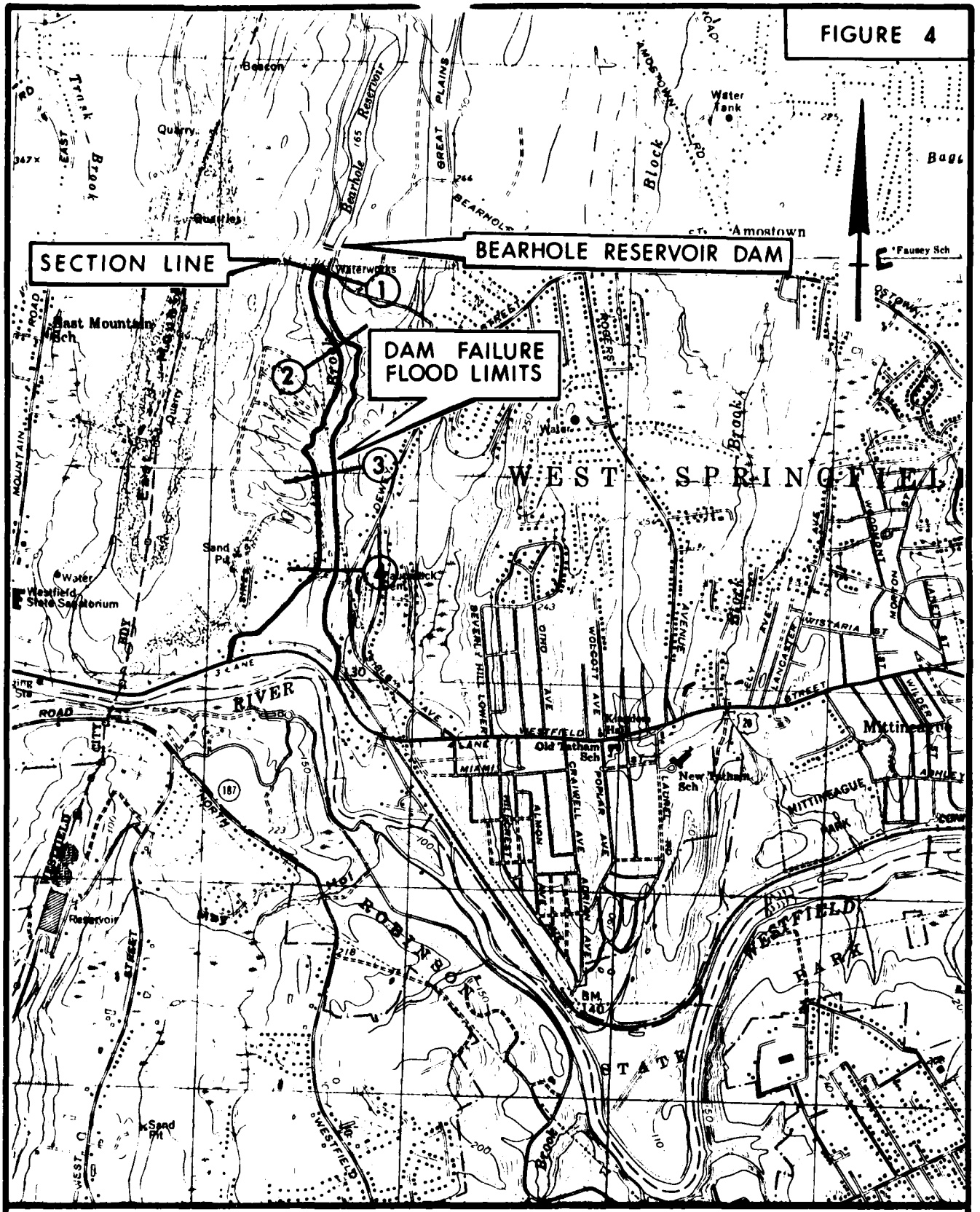
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION
OF NON-FED. DAMS
WATERSHED
BEARHOLE RESERVOIR DAM
WEST SPRINGFIELD, MASS.

SCALE 1" = 2083'		DATE MARCH 1981	
DWN NP	CKD GV	APP KH	PAGE D-1

CULLINAN ENGINEERING CO., INC.
CIVIL ENGINEERS
AUBURN – BOSTON, MASSACHUSETTS

FIGURE 4



DAM FAILURE FLOOD LIMITS
BEARHOLE RESERVOIR DAM
WEST SPRINGFIELD , MASS.
1" = 2083'

CULLINAN ENGINEERING CO., INC.

MOUNT TOM QUADRANGLE 1979
WEST SPRINGFIELD , MASS-CONN QUADRANGLE 1979

CLIENT / PROJECT U.S. Army COE / Non-Federal Dams DATE 2/4/81 JOB NO.

SUBJECT Bearhole Reservoir Analysis and Evaluation BY GMV CHKD BY JDP SHEET 1 OF 14

I. Classification:

Size: storage (max.) = 450 Ac. Ft. ∴ Small
height (struct.) = 36 Ft. ∴ Small

Hazard Potential: field investigation indicates that if failure were to occur with the water surface at the top of the dam, a water treatment facility and pumping station immediately downstream would be destroyed causing a sizable economic loss and possible loss of life, therefore, hazard potential is considered Significant

II. Spillway Design Flood:

With a significant hazard potential and a small dam, the COE "Recommended Guidelines for Safety Inspection of Dams" indicates that a test flood in the 100 Year Frequency to $\frac{1}{2}$ Probable Maximum Flood range is appropriate.

∴ Determine SDF using $\frac{1}{2}$ PMF (due to appreciable economic loss and possible loss of a few lives)

III. Inflow Hydrograph:

Tributary Area = 3475 Acres = 5.43 Sq. Miles
Terrain is Rolling (from inspection of USGS Mount Tom Quad)

∴ From COE "Maximum Probable Flood Peak Flow Rates"
PMF (CSM) = 1820 CSM

∴ SDF = $\frac{1}{2}$ PMF = 0.5 x 1820 CSM x 5.43 Sq. Miles = 4940 cfs

Time to peak $t_p = \frac{484AQ}{q_p}$

Where: A = Drainage Area = 5.43 Sq. Miles
Q = Total Runoff = 9.5 Inches $\left(\frac{PMP}{2}\right)$
q_p = Peak Flow = 4940 cfs

∴ $t_p = \frac{484 \times 5.43 \times 9.5}{4940} = 5.1$ hrs. (303 Min.)

Time base for hydrograph $t_b = 2.67 t_p$

∴ $t_b = 2.67 \times 5.1 = 13.5$ hrs. (810 Min.)

AD-A145 217 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS BEARHOLE RESERVOIR (M..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV JUN 81 2/2

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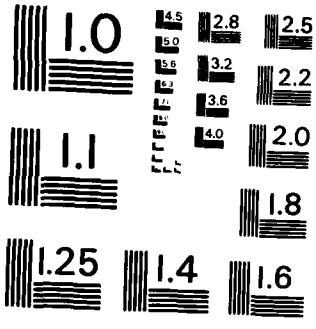
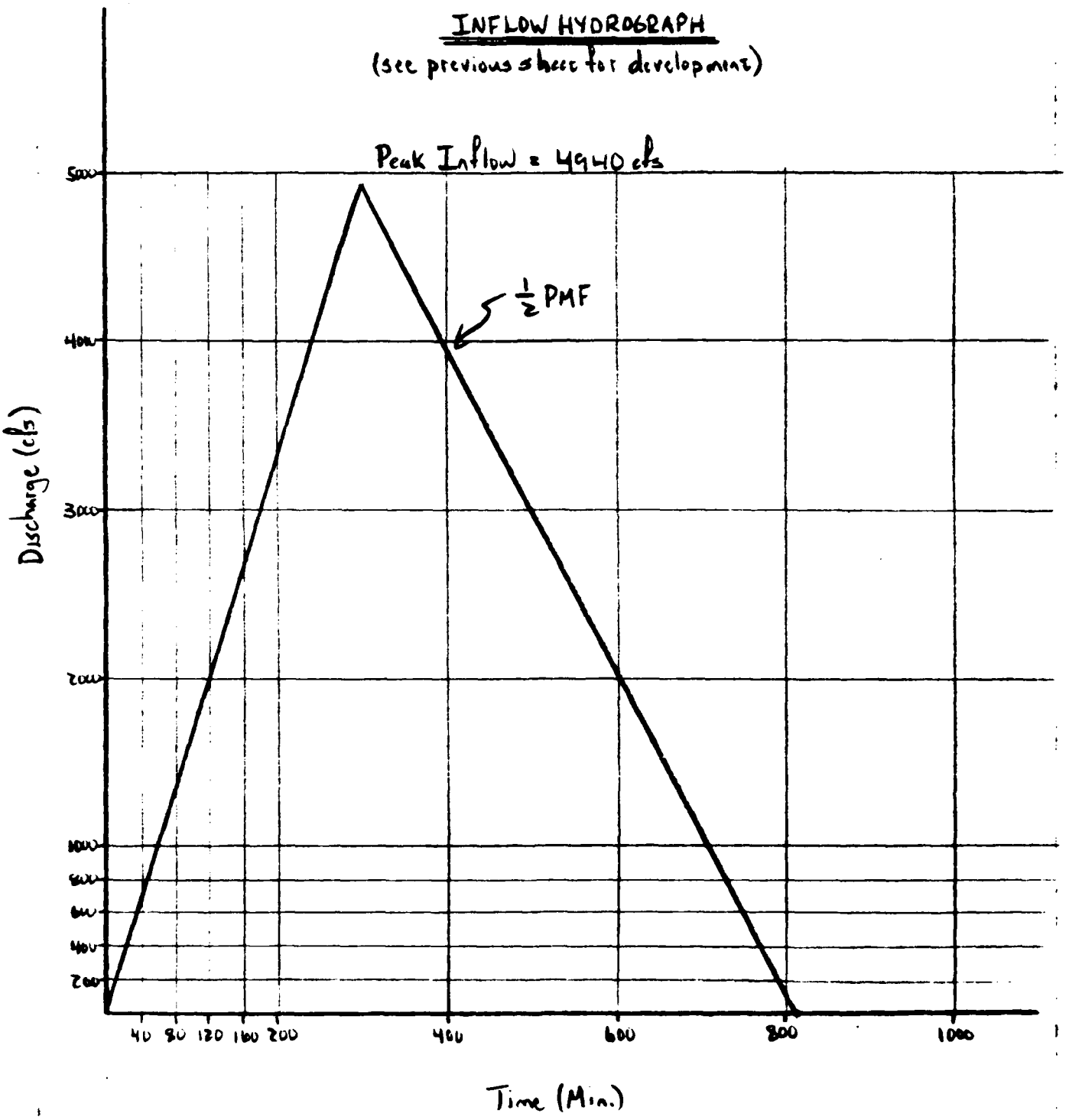


CLIENT / PROJECT U.S. Army COE / Non-Federal Dams DATE 2/4/81 JOB NO.

SUBJECT Bearhole Reservoir Analysis and Evaluation BY GMV CHKD. BY JDP SHEET 2 OF 14

INFLOW HYDROGRAPH

(see previous sheet for development)



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CIVIL ENGINEERS — LAND SURVEYORS

IV. Flood Routing:

Stage Discharge Data – to develop the stage storage data, it will be assumed that discharge is primarily over three spillways; elevations will be developed from field investigation assuming that the normal water level (elev. 165 from USGS) is at the lower of the two long spillways.

A. 6' Long Spillway at Elev. 163.75
B. 50' Long Spillway at Elev. 165.0
C. 60' Long Spillway at Elev. 165.25
D. 270' long Embankment at Elev. 172.0

Discharge for all of the above is given by

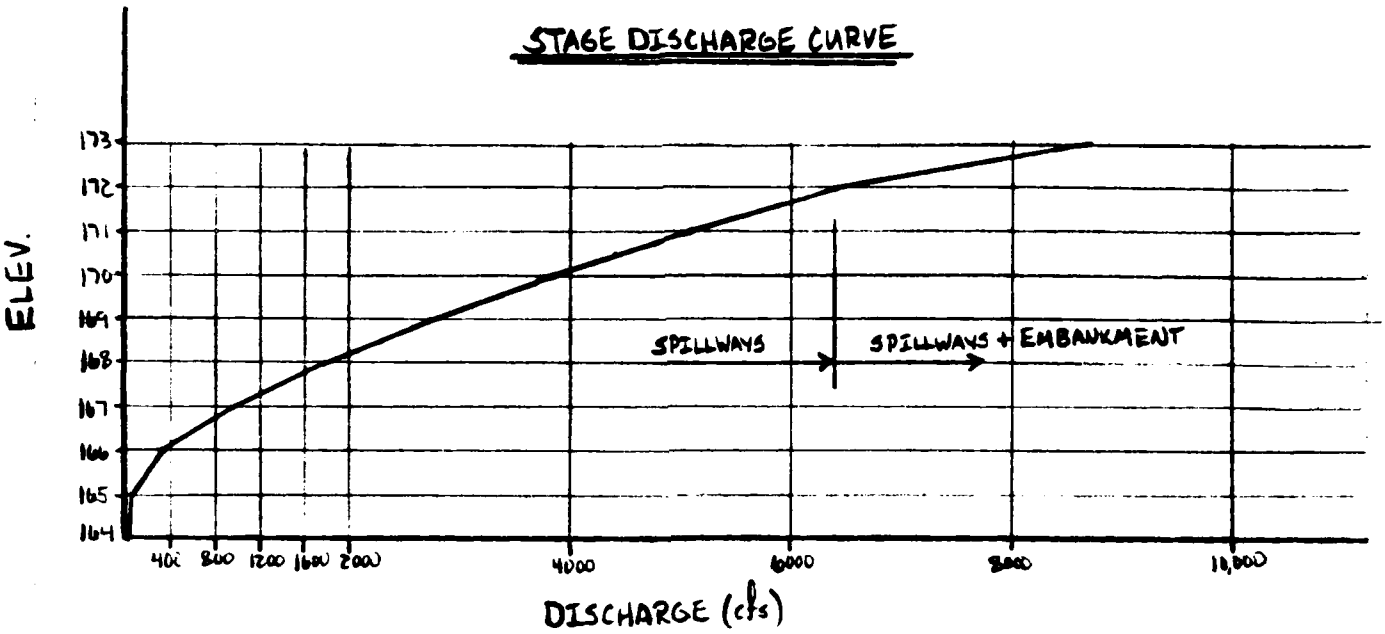
$Q = 3.03 L H^{3/2}$ Where L = length of weir (spillway)
H = height over weir

NOTE: Flashboards may be used to raise the crest elev. of the 6' long spillway to 165 ±, however, since this analysis will neglect any discharge through the various pipe outlets (sluice gates assumed closed), it will be assumed that the flashboards are not in place.

ELEV.	H_A	H_B	H_C	H_D	Q_A	Q_B	Q_C	Q_D	Q_{TOTAL} (CFS)
164	0.25'	-	-	-	2.3 cfs	-	-	-	2.3
165	1.25'	-	-	-	25.4 cfs	-	-	-	25.4
166	2.25'	1.0'	0.75'	-	61.4 cfs	151.5 cfs	118.1 cfs	-	331
167	3.25'	2.0'	1.75'	-	106.5 cfs	428.5 cfs	420.9 cfs	-	956
168	4.25'	3.0'	2.75'	-	159.3 cfs	787.2 cfs	829.1 cfs	-	1776
169	5.25'	4.0'	3.75'	-	218.7 cfs	1212 cfs	1320 cfs	-	2751
170	6.25'	5.0'	4.75'	-	284.1 cfs	1694 cfs	1882 cfs	-	3860
171	7.25'	6.0'	5.75'	-	354.9 cfs	2227 cfs	2507 cfs	-	5089
172	8.25'	7.0'	6.75'	-	430.8 cfs	2806 cfs	3188 cfs	-	6425
173	9.25'	8.0'	7.75'	1.0'	511.5 cfs	3428 cfs	3922 cfs	818.1 cfs	8680

CLIENT / PROJECT U.S. Army COE / Non-Federal Dams DATE 2/5/81 JOB NO
SUBJECT Bearhole Reservoir Analysis and Evaluation BY GMV CHKD BY JDP SHEET 4 OF 14

IV. Flood Routing: cont.



Stage Storage Data — to develop the stage storage curve, the areas at elevations 165, 170, and 180 will be determined from the USGS Mount Tom Quad and averaged to compute the volumes. The volume between elevations 164 and 165 will be determined assuming vertical sides on the reservoir.

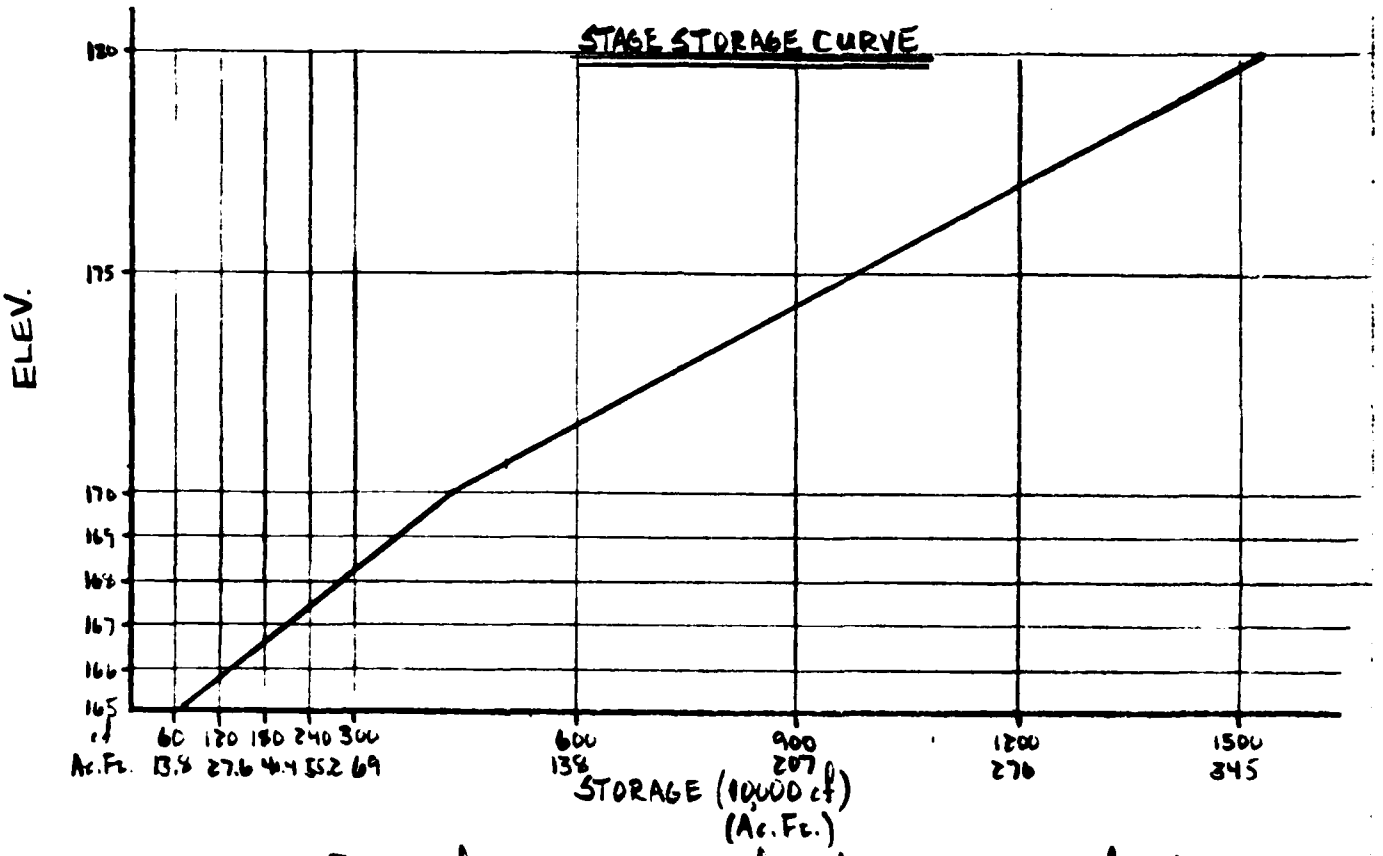
Area @ Elev. 165 = 738,000 sf
Area @ Elev. 170 = 998,000 sf
Area @ Elev. 180 = 1,194,000 sf

∴ Storage Volume @ 165 = 738,000 cf (99.6 Ac.Ft.)
Storage Volume @ 170 = [(738,000 + 998,000) ÷ 2] x 5 = 4,340,000 cf
Storage Volume @ 180 = [(1,194,000 + 998,000) ÷ 2] x 10 + 4,340,000
= 15,300,000 cf (or 351.2 Ac.Ft.)

CLIENT / PROJECT U.S. Army COE / Non-Federal Dams DATE 2/5/81 JOB NO

SUBJECT Bearhole Reservoir Analysis and Evaluation BY GMV CHKD BY DP SHEET 5 OF 14

IV. Flood Routing: cont.



Routing of the SDF will be performed using the program for Muskingum Method Hydrograph Routing as contained in the text entitled "Hydrologic and Hydraulic Computations on Small Programmable Calculators" by Thomas E. Croley II.

Δt = 10 min.

X = 0 (reservoir routing)

K = approximated as slope of line obtained by plotting storage vs. outflow

storage @ el. 171 = 5.4×10^6 cf

outflow @ el. 171 = 5089 cfs

$\therefore K = \frac{5.4 \times 10^6 \text{ cf}}{5089 \text{ cfs}} \times \frac{1 \text{ min.}}{60 \text{ sec.}} = 17.7$ SAY 18 Min.

IV. Flood Routing: cont.

TIME	INFLOW	OUTFLOW
0 min	0 cfs	0 cfs
10	163	* 1.7
20	326	107
30	489	238
40	652	382
50	815	535
60	978	692
70	1141	852
80	1304	1013
90	1467	1175
100	1630	1337
110	1793	1500
120	1956	1663
130	2119	1826
140	2282	1989
150	2445	2152
160	2608	2315
170	2771	2478
180	2934	2641
190	3097	2804
200	3260	2967
210	3423	3130
220	3586	3293
230	3749	3456
240	3912	3619
250	4075	3782
260	4238	3945
270	4401	4108
280	4564	4271
290	4727	4434
300	4890	4597
310	4872	4720
320	4775	4765
330	4678	4748
340	4581	4697
350	4484	4625
360	4387	4543
370	4290	4454
380	4193	4362
390	4096	4267
400	3999	4172

* Starting Value - $I_1 + I_2 + \frac{2S_1}{\Delta t} - O_1 = \frac{2S_2}{\Delta t} + O_2$ $\therefore I_1 + I_2 = 163 \text{ cfs} = \frac{2S_2}{\Delta t} + O_2$

Eq. 165 $\frac{2S_2}{\Delta t} + O_2 = 2485.4$ cfs $O_2 = 25.4$ cfs

$\therefore \frac{163}{2485.4} = \frac{O}{25.4} \Rightarrow O = 1.7$ cfs

IV. Flood Routing: cont.

Analysis of the test flood routing indicates that a peak outflow of 4770 cfs ± at a water surface elevation of 170.8 ± would occur as a result of an event producing a reservoir inflow equal to $\frac{1}{2}$ of the Probable Maximum Flood. This indicates a freeboard of 1.2 feet during the test. Because of the steepness of the reservoir sides, it is likely that the full Probable Maximum Flood would overtop the dam, therefore, the failure analysis following will be performed with the water initially at the top of the dam.

V. Dam Failure Analysis:

To assess the downstream impacts due to dam failure, it will be assumed that 40% of the embankment will breach at mid-height as a result of the test flood ($\frac{1}{2}$ PMF).

Length of Dam at Mid Height = 150 ft.
Assume Breach Width W_B = 40% of length @ Mid Height
$\therefore W_B = 0.40 \times 150 = 60$ ft.
Top of Dam Elev. = 172.0
Downstream Elevation = 138 ± (field observation)
$\therefore Y_o = 172.0 - 138 = 34.0$ ft.
Peak Failure Outflow $Q_{P_1} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$

$$\therefore Q_{P_1} = \frac{8}{27} \times 60 \times \sqrt{32.2} \times (34.0)^{3/2} = 20{,}000 \text{ cfs}$$

VI. Downstream Dam Failure Analysis:

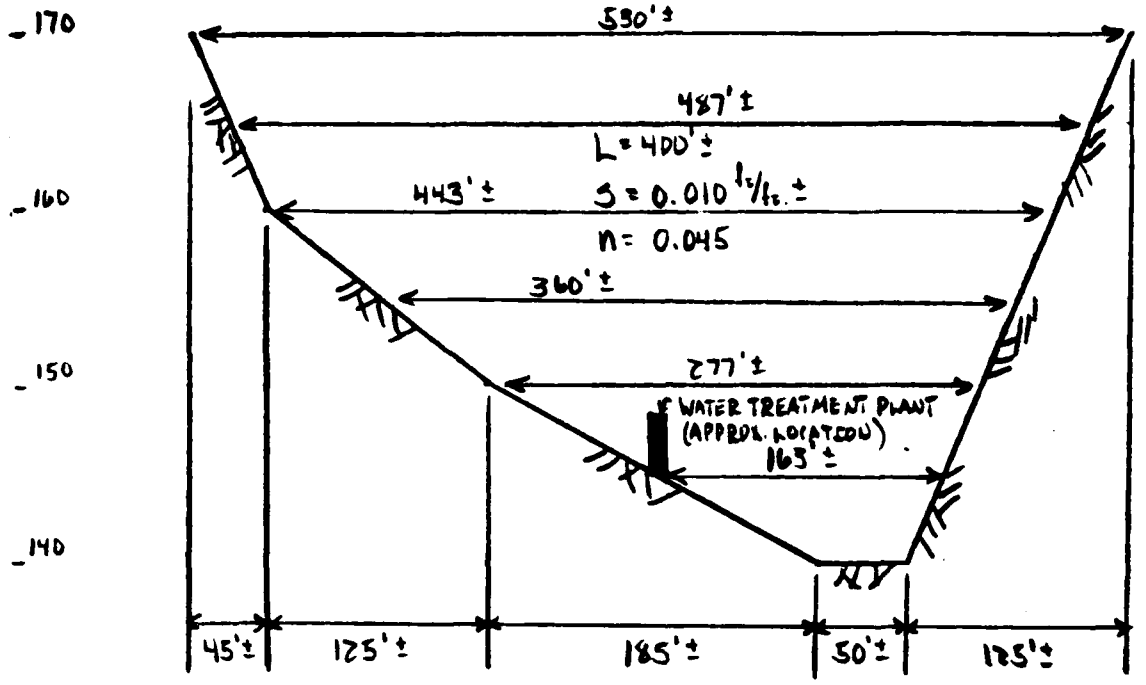
Following the breaching of the dam, the failure outflow would travel south through a valley containing Pancatuck Brook. The first section of any importance encountered is the water treatment plant and pumping station approximately 400 ft. downstream of the dam. Downstream of the pumping station there are no significant structures or important economic areas.

CLIENT / PROJECT U.S. Army COE / Non-Federal Dams DATE 2/5/01 JOB NO

SUBJECT Beachole Reservoir Analysis and Evaluation BY GMV CHKD BY JDP SHEET 8 OF 14

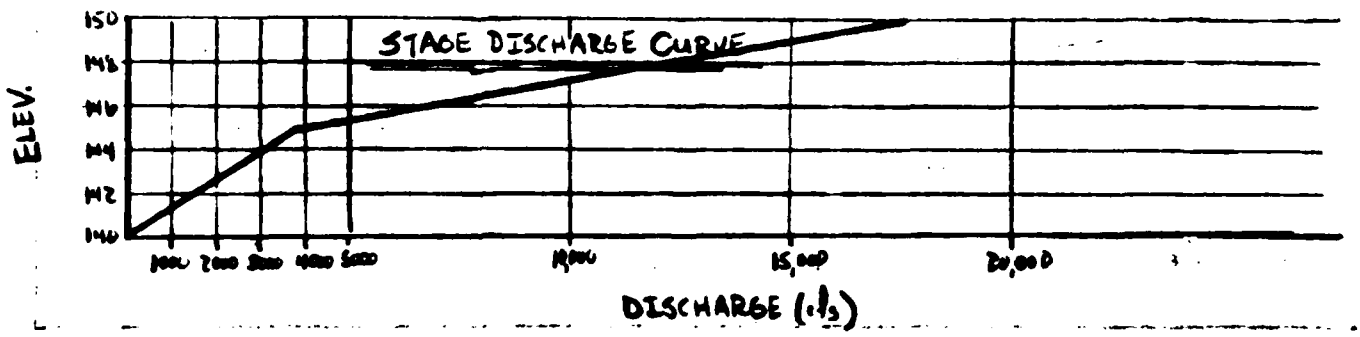
VI. Downstream Dam Failure Analysis: cont.

① Section 400'± downstream of dam (from USGS) 1" = 100' Horiz. 1" = 10' Vert.

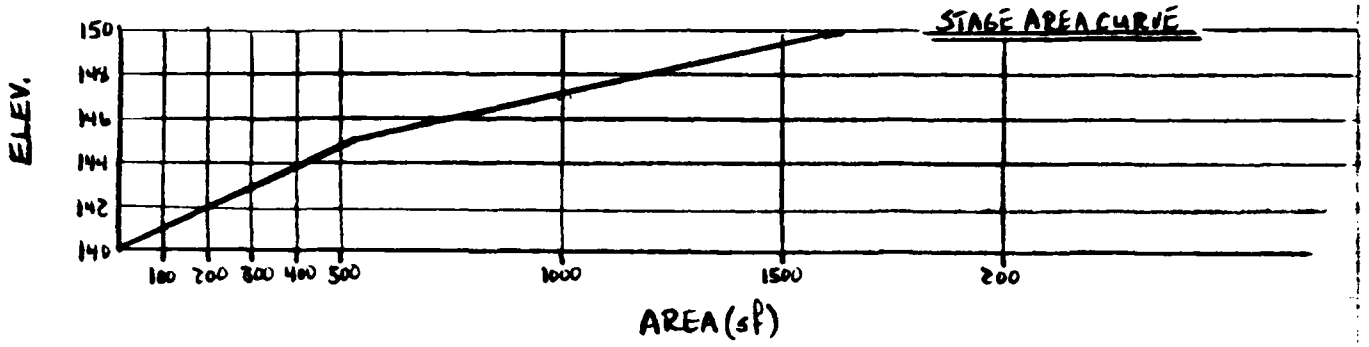


ELEV.	AREA(A)	WP	HYDRAULIC RADIUS(R)	$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$
145	533 sf	164 ft.	533 ÷ 164 = 3.25 ft.	3862 cfs
150	1633 sf	278 ft.	1633 ÷ 278 = 5.87 ft.	17,548 cfs
155	3226 sf	362 ft.	3226 ÷ 362 = 8.91 ft.	45,285 cfs
160	5233 sf	446 ft.	5233 ÷ 446 = 11.7 ft.	89,060 cfs
165	7558 sf	490 ft.	7558 ÷ 490 = 15.4 ft.	154,488 cfs
170	10,100 sf	534 ft.	10,100 ÷ 534 = 18.9 ft.	236,648 cfs

NOT PLOTTED > Q_{P_1}



VI. Downstream Dam Failure Analysis: cont.



For Failure at Elev. 172.0':

Total Failure Outflow = Breach Failure Outflow

Q_{p_1} = 20,000 cfs

Total Storage at Failure = Storage at Spilling Elev. + Surcharge Storage

Storage at Spilling Elev. = 450 Ac. Ft. (from inventory sheet)

Surcharge Storage = $6,532,000 \times \frac{1}{43,560}$ = 150 Ac. Ft. ±

∴ Total Storage at Failure S = 450 + 150 = 600 Ac. Ft.

@ Q_{p_1} = 20,000 cfs

H = 10.4 ft. ± (Elev. 160.4±)

$V_1 = 1770 sf \times 400 ft. \times \frac{1}{43,560}$ = 16.3 Ac. Ft. < $\frac{1}{2}$ S ∴ Reach is OK

$\therefore Q_{p_2}(TRIAL) = Q_{p_1}\left(1 - \frac{V_1}{S}\right) = 20,000\left(1 - \frac{16.3}{600}\right)$ = 19,458 cfs

@ $Q_{p_2}(TRIAL)$ = 19,458 cfs

H = 10.3 ft. ± (Elev. 150.3±)

$V_2 = 1740 sf \times 400 ft \times \frac{1}{43,560}$ = 16.0 Ac. Ft.

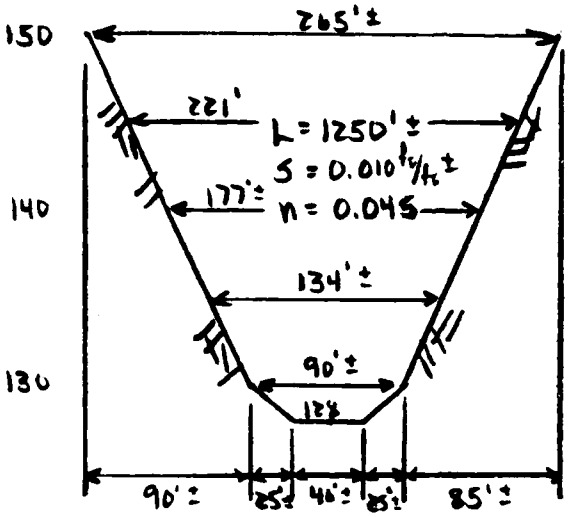
$\therefore V_{AVG} = \frac{V_1 + V_2}{2} = \frac{16.3 + 16.0}{2}$ = 16.15 Ac. Ft.

$\therefore Q_{p_2} = Q_{p_1}\left(1 - \frac{V_{AVG}}{S}\right) = 20,000\left(1 - \frac{16.15}{600}\right)$ = 19,462 cfs H=10.3' A=1740sf

Elevation of 150.3± is indicated which would inundate the water treatment plant and pumping station (elev. 145± ⇒ 5'± of water)

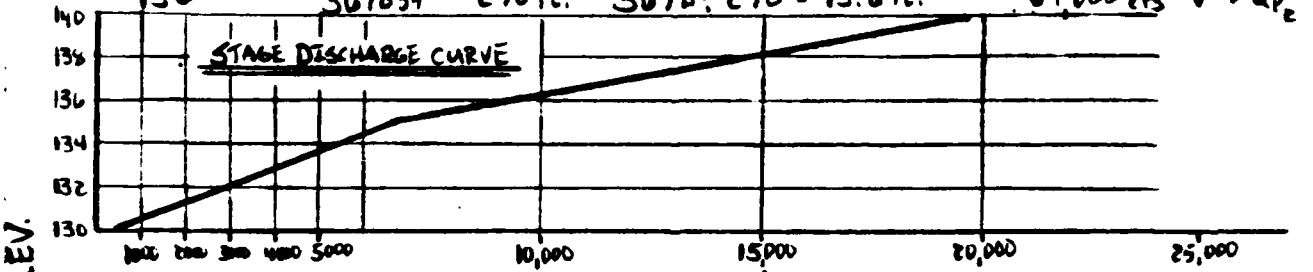
VI. Downstream Dam Failure Analysis : cont.

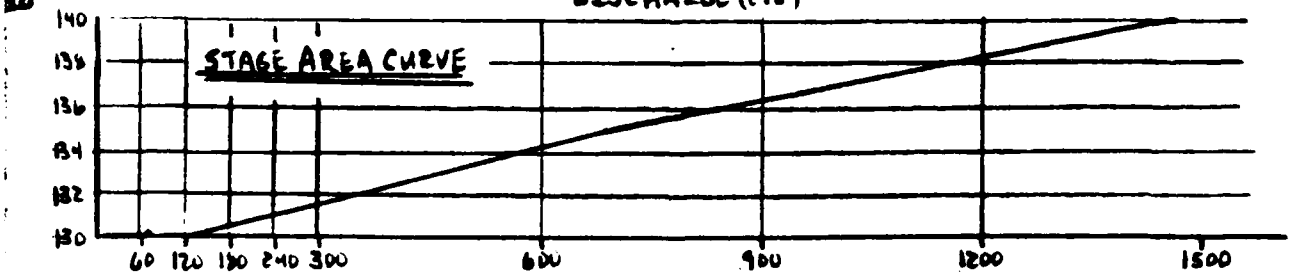
(E) Section 1650'± downstream of dam (from USGS) 1" = 100' Horiz. 1" = 10' Vert.



ELEV.	AREA (A)	WP	HYDRAULIC RADIUS (R)	$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$
130	130 sf	90 ft.	130 ÷ 90 = 1.44 ft.	547 cfs
135	690 sf	135 ft.	690 ÷ 135 = 5.11 ft.	6760 cfs
140	1468 sf	180 ft.	1468 ÷ 180 = 8.16 ft.	19,648 cfs
145	2463 sf	225 ft.	2463 ÷ 225 = 11.0 ft.	40,228 cfs
150	3678 sf	270 ft.	3678 ÷ 270 = 13.6 ft.	69,200 cfs

NOT PLOTTED > Q_{P_E}





VI. Downstream Dam Failure Analysis: cont.

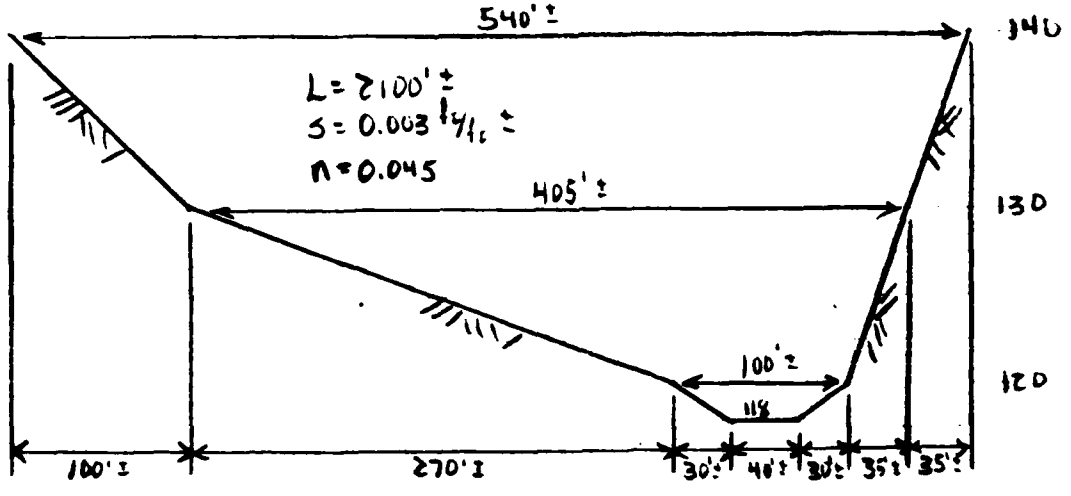
@ Q_{P_2} = 19,462 cfs
H = 11.9 ft. ± (Elev. 139.9±)
$V_1 = \frac{1340+1460}{2} \times 1250 \times \frac{1}{43,560}$ = 46 Ac.Ft. < $\frac{1}{2}S$ ∴ Reach is OK

$\therefore Q_{P_3}(TRIAL) = Q_{P_2}\left(1-\frac{V_1}{S}\right) = 19,462\left(1-\frac{46}{600}\right)$ = 17,973 cfs

@ Q_{P_3} (TRIAL) = 17,973 cfs
H = 11.4 ft. ± (Elev. 139.4±) ⇒ V = 45, V_{ADJ} = 45.5 Ac.Ft.

$\therefore$ SAY $Q_{P_3} = 19,462\left(1-\frac{45.5}{600}\right)$ = 17,986 cfs H = 11.4 ft.± A = 1370 sf ±

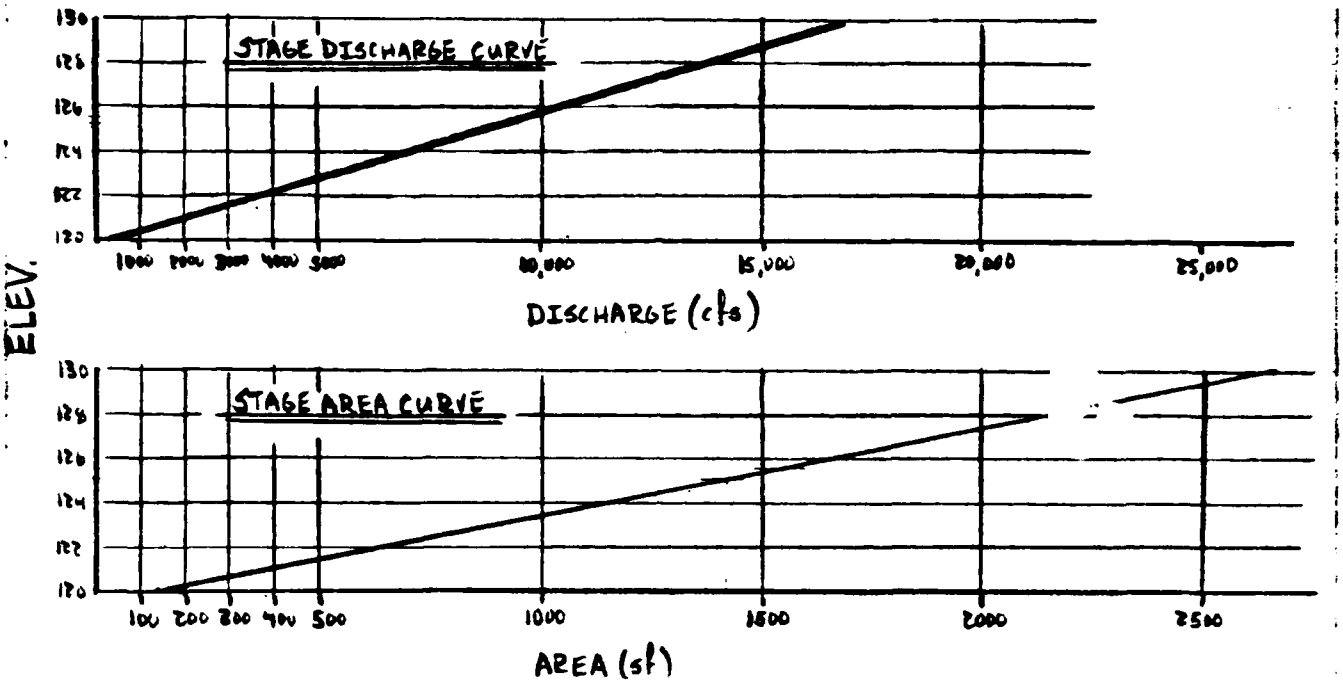
③ Section 3750' downstream of dam (from USGS) 1" = 100' Horiz. 1" = 10' Vert.



ELEV.	AREA (A)	WP	HYDRAULIC RADIUS (R)	$Q = \frac{1.486}{n} AR^{2/3}S^{1/2}$
120	140 sf	100 ft.	140 ÷ 100 = 1.40 ft.	317 cfs
130	2665 sf	407 ft.	2665 ÷ 407 = 6.55 ft.	16,874 cfs
140	7390 sf	544 ft.	7390 ÷ 444 = 13.6 ft.	76,156 cfs ↓

NOT PLOTTED
$> Q_{P_3}$

VI. Downstream Dam Failure Analysis: cont.



A tributary to Pancatuck Brook flows into the main channel upstream of the section under study. The tributary area to the brook at this section is 960 Acres (1.5 Sq. Miles) which, assuming $\frac{1}{2}$ PMF for rolling terrain, yields an additional inflow to Pancatuck Brook of 1600 cfs. Since this is less than 10% of the failure outflow, it will be neglected.

@ $Q_{P_3} = 17{,}986$ cfs

$H = 12.2$ ft (Elev. 130.2 ±)

$V_1 = \frac{1370+2755}{2} \times 2100 \times \frac{1}{43{,}560} = 119$ Ac. Ft. $< \frac{1}{2} S$ ∴ Reach is OK

$\therefore Q_{P_4}(\text{TRIAL}) = Q_{P_3}\left(1 - \frac{V_1}{S}\right) = 17{,}986\left(1 - \frac{99}{800}\right) = 15{,}018$ cfs

@ $Q_{P_4}(\text{TRIAL}) = 15{,}018$ cfs

$H = 10.8$ ft (Elev. 128.8 ±)

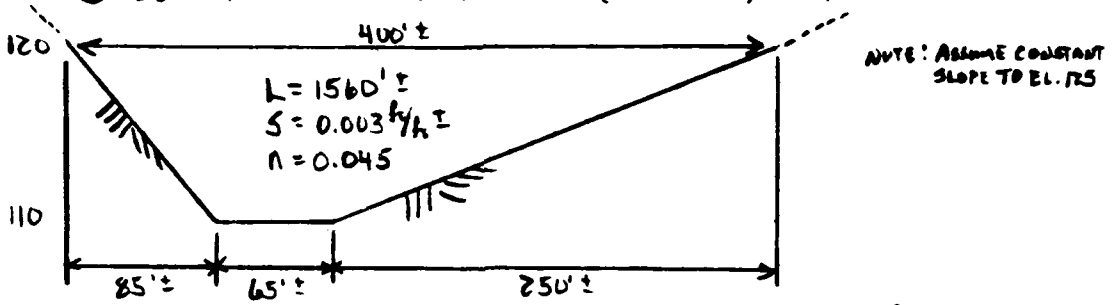
$V_2 = \frac{1370+2350}{2} \times 2100 \times \frac{1}{43{,}560} = 90$ Ac. Ft.

VI. Downstream Dam Failure Analysis: cont.

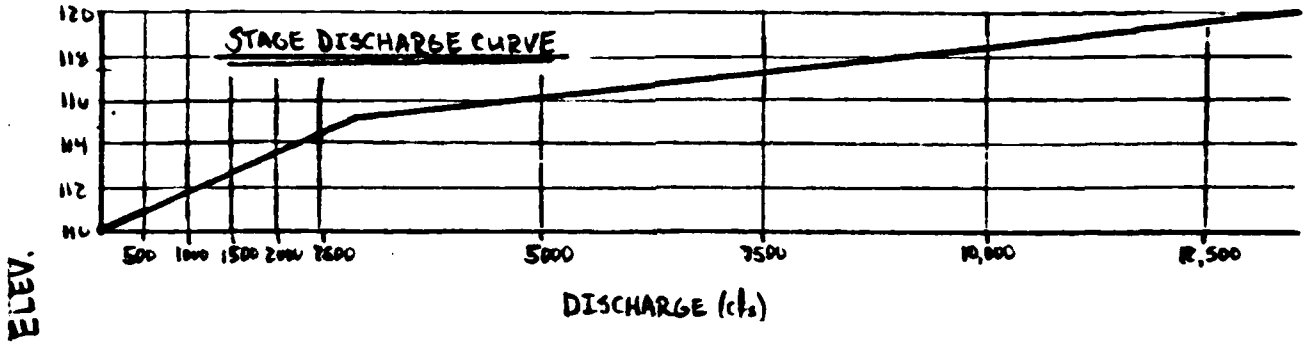
$\therefore V_{Avg} = \frac{199 + 90}{2} = 94.5$ Ac.Ft.

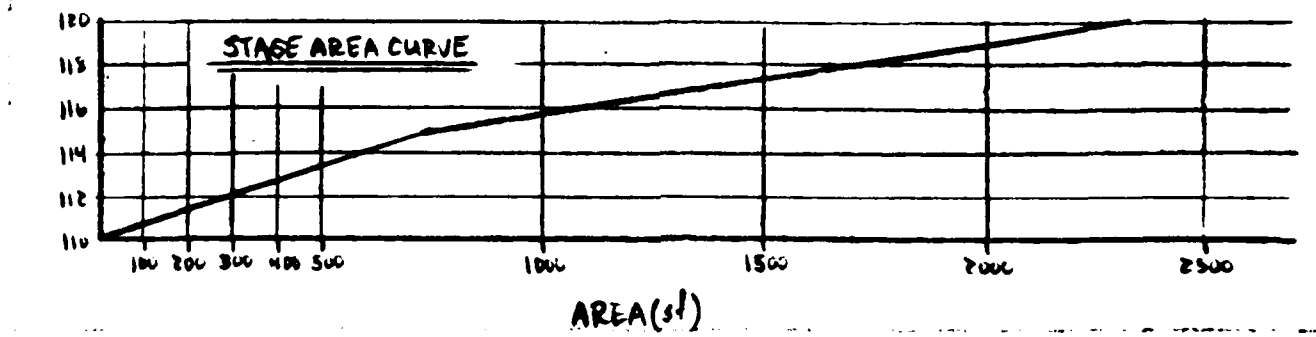
$\therefore Q_{P_4} = Q_{P_3}\left(1 - \frac{V_{Avg}}{5}\right) = 17,986\left(1 - \frac{94.5}{600}\right) = 15,153$ cfs H = 11.0 ft. A = 2400 sf

④ Section 5310' downstream of dam (from USGS) 1" = 100' Horiz. 1" = 10' Vert.



ELEV.	AREA(A)	WP	HYDRAULIC RADIUS(R)	$Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$
115	744 sf	233 ft.	744 ÷ 233 = 3.19 ft.	2916 cfs
120	2325 sf	401 ft.	2325 ÷ 401 = 5.80 ft.	13,575 cfs
125	4648 sf	465 ft.	4648 ÷ 465 = 10.0	39,031 cfs





VI. Downstream Dam Failure Analysis: cont.

Additional tributary area is minor at this point and will, therefore, be neglected.

@ Q_{P_4} = 15,153 cfs

H = 10.3 ft. ± (Elev. 120.3±)

$V_1 = \frac{2400+2470}{2} \times 1560 \times \frac{1}{43,560} = 87$ Ac.Ft. < ±5 ∴ Reach is OK

$\therefore Q_{P_5}(\text{TRIAL}) = Q_{P_4}\left(1-\frac{V_1}{5}\right) = 15,153\left(1-\frac{87}{600}\right) = 12,951$ cfs

@ $Q_{P_5}(\text{TRIAL})$ = 12,951 cfs

H = 9.7 ft ± (Elev. 119.7 ±)

$V_2 = \frac{2400+2220}{2} \times 1560 \times \frac{1}{43,560} = 83$ Ac. Ft.

$\therefore V_{AVG} = \frac{87+83}{2} = 85$ Ac. Ft.

$\therefore Q_{P_5} = Q_{P_4}\left(1-\frac{V_{AVG}}{5}\right) = 15,153\left(1-\frac{85}{600}\right) = 13,006$ cfs H = 9.7 ft. ±, A = 2240 sf ±

Approximately 500' downstream of the previous section there is a minor street that would probably be subject to some flooding in the event of a dam failure. Downstream of that, there is another minor street (±950ft.), railroad tracks (±1000ft), a major highway (Rte. 20, ±1250ft.) and, finally, the Westfield River (±1450ft.), all of which may be subject to flooding due to the dam failure outflow. The hazard potential for this dam is based upon the economic loss that would be sustained due to the loss of water supply and damage to the water treatment plant.

DAMAGE AREA	PRE-FAILURE ELEV.	POST-FAILURE ELEV.	ELEV. OF DAMAGE AREA
WATER TREATMENT PLANT	145.9±	150.3±	145±

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME


DATE
ILMED
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